THE CONSTRUCT VALIDITY OF DSM-IV ATTENTION DEFICIT HYPERACTIVITY DISORDER

RON TALLENT (B. A., Hons.; Dip. Ed.; Grad. Dip. Psych..)

A thesis submitted in fulfillment of the

requirements for the degree of

Doctor of Philosophy

School of Behavioural and Social Sciences and Humanities

University of Ballarat

August, 2003

ACKNOWLEDGEMENTS

I would like to extend my gratitude to the many people who have contributed to the production of this thesis.

First and foremost, to my supervisor, Associate Professor Rapson Gomez, for your knowledge, understanding, critical thinking, friendship, dedication, encouragement and inspiration.

To those of my colleagues at Ballarat University who have been there, and know "the hard grind" of social isolation, self-doubt, satisfaction and exhilaration. In particular, thanks to Kevin and Alan (my computer gurus), Alison (my critical adviser), Di Clingin (my SEDS saviour), Jan, Caroline, Terence, Briony, Angela, and Kate for your special friendship, and those moments of stimulation, fun and frivolity.

To all who assisted in recruiting children for this study, in particular Dr. Bernie Jenner and his team. To the many children who participated in the study, and to the parents and teachers for your involvement and contribution.

To my stepson Alistair, despite ADHD giving you a life of unnecessary trauma and uncertainty, your disability has taught me so much about life and myself; and I have grown to know a unique and beautiful person of whom I am very proud.

To my two wonder dogs Gemma and Nugget – my constant companions during the past four years; you were always there to cheer me up, and share those walks in the forest so necessary to keep me reasonably sane.

And especially to Joan, we've had our differences, but you've stuck with me through the highs and lows, and this thesis would not have been possible without your support, understanding, love, cups of tea and bikkies, and "being there".

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study examined the internal (Study 1) and external (Study 2) validity of DSM-IV ADHD using children with a primary ADHD diagnosis. Study 1 had two aims. The first aim was to use single source confirmatory factor analysis (CFA) to test the factor structure of the ADHD symptoms. The second aim was to use CFA multitrait-multisource (MTMS) analysis to test the convergent and discriminant validities, and the trait, source and error variance of the ADHD symptoms. Participants were 223 school-age ADHD children with ages ranging from 7-13 years. Teachers and parents completed a questionnaire comprising the 18 DSM-IV ADHD symptoms. The single source CFA results provided support for a two-factor structure comprising separate factors for inattention (IA) and hyperactivity-impulsivity (H/I), and a three-factor structure comprising separate factors for inattention (IA), hyperactivity (HYP), and impulsivity (IMP). The results of the CFA MTMS analysis provided good support for the convergent validity, but only modest support for the discriminant validity of the IA and H/I dimensions at the matrix level. However at the individual parameters level (involving 2 parcels for each of the IA and H/I symptoms), there was significant trait variance for teacher IA and parent H/I, but negligible trait variance for teacher H/I and parent IA. In general teachers and parents had more source than trait effects. The higher source effect questions the results of the convergent and discriminant validity of the IA and H/I dimensions at the matrix level. Study 2, examined the external validity of the ADHD subtypes. It compared the ADHD inattentive subtype (IA; N = 32), hyperactive-impulsive subtype (H/I; N = 11), combined subtype (C; N = 52), and normal control group (N = 34) for a range of measures. These measures were IQ, academic functioning (WIAT subtests for reading, spelling, maths), the children's social cognitions (hostile interpretation of intent, hostile response selection, and emotional response state), the children's ratings of maternal parenting style (warm, rejecting, overprotective); teacher and mother ratings of children's ODD, anxiety, and aggression style (proactive, covert, reactive); and also maternal self-report of mental health. The results indicated no differences among groups, excepting the reading subtest and the different measures of aggression style. For the reading subtest the C subtype had a lower score than the IA, H/I subtypes and control group. There were no differences between the IA, H/I and control groups. For teacher ratings of reactive aggression, the C subtype had higher scores than the IA subtype. There were no differences between the H/I and C subtypes, and the three subtypes had higher scores than controls. For mother ratings of proactive aggression, the H/I and C subtypes had higher scores than the IA subtype, and the three subtypes had higher scores than the control group. For mother ratings of covert aggression, the C subtype had higher scores than the IA, H/I subtypes and controls, and there were no differences between the IA, H/I subtypes and control group. Overall, the C subtype had more aggression style problems than the IA subtype, and there were few differences between the H/I subtype and control group. The data can be interpreted as providing support for the external validity of the IA and C subtypes. The findings of this study are discussed in terms of the validity of the ADHD symptoms and subtypes, and their implications for the conceptualisation, assessment, diagnosis, and treatment of ADHD.

DECLARATION

The research report in this thesis is entirely original. It has not been, and is not being, submitted for the award of any degree or diploma at any other university. Except where due reference is made, all other material contained in this thesis is the author's own work.

CHAPTER 1

OVERVIEW OF ATTENTION DEFICIT HYPERACTIVITY DISORDER

Attention deficit hyperactivity disorder (ADHD), among the most common childhood disorders, has been the subject of research for nearly a century (Barkley, 1990; Campbell & Werry, 1986; Schachar, 1986). Indeed over the last three decades there has been a plethora of research aimed at examining the aetiology and characteristics of this disorder. The aim of this chapter is to provide a brief overview of ADHD. Among the areas covered are primary symptoms, diagnosis, aetiology, prevalence and gender ratios, prognosis and outcome, treatment response, theoretical underpinnings of the disorder, and major comorbid disorders.

1 . 1 Primary symptoms

It is generally accepted that the primary symptoms of ADHD are inattention, motor activity, and impulsivity. A large number of studies have attested to the distinction between the core dimensions of inattention and hyperactivity-impulsivity. Inattention has been characterised by difficulty sustaining attention to tasks or play activities, low persistence levels, poor organisational skills, failure to understand instructions, and avoidance of sustained mental effort (Barkley, DuPaul, & McMurray, 1990; Cantwell & Baker, 1992; Cantwell & Satterfield, 1978; Zentall, 1993). Hyperactivity has been characterised by fidgeting, an inability to remain still when required, excessive and inappropriate movement, difficulty playing quietly, and the appearance of being driven by a motor. Impulsivity has been characterised by impatience, difficulty in delaying responses, blurting out answers before questions have been completed, difficulty awaiting one's turn, and frequent interruptions or intrusions on others (Anderson, Williams, McGee, & Silva, 1989; Barkley et al., 1990; Halperin, Matier, Bedi, Sharma, & Newcorn, 1992; Lahey, Carlson, & Frick, 1997).

1 . 2 Diagnosis

1 . 2 . 1 Clinical (categorical) approach

At present clinical diagnosis of ADHD is based on either the World Health Organisation, International Classification of Diseases (WHO; ICD-10, 1992) or the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 1994).

With respect to the DSM classification system, ADHD's definition has changed substantially since DSM-III in 1980. Differences in symptoms, symptom numbers, and different symptom organisation have characterised the evolution from DSM-III to DSM-IV. The currently employed system of DSM-IV requires at least 6 of 9 symptoms of each of the dimensions of inattention or hyperactivity-impulsivity for diagnosis. The symptoms must have persisted at a maladaptive developmental level for a minimum of 6 months duration.

While the DSM-III-R symptom list implied that ADHD was a unitary disorder, DSM-IV clearly delineates three categorical subtypes: a predominantly inattentive subtype, a predominantly hyperactive-impulsive subtype, and a predominantly combined inattentive and hyperactive-impulsive subtype. To satisfy diagnosis of the inattentive subtype 6 of the 9 symptoms must be present. Similarly, to satisfy diagnosis of the hyperactive-impulsive subtype 6 of the 9 symptoms must be present. A diagnosis of the combined subtype is met if 6 inattention symptoms, and 6 hyperactivity-impulsivity symptoms are present.

DSM-IV also tightened the cross-situational criteria that first appeared in DSM-III, and had been further modified in DSM-III-R. It was specified that the ADHD symptoms should be present in two or more settings (eg., home, school, or work), and there must be clear evidence of clinically significant impairment in social, academic, or occupational functioning (APA, 1994, p. 84).

Despite the improvements in diagnostic classification afforded by DSM-IV, there are still several problems limiting its usefulness. Research has identified problems associated with the validity of the hyperactive-impulsive subtype, age of onset, symptom cutoff and diagnostic thresholds, lower age boundaries, and situational impairment criterion (Applegate et al., 1997; Barkley, 1997; Faraone, Biederman, Weber, & Russell, 1998; Lahey et al., 1997; McBurnett, 1997; Power et al., 1998). Chapter 2 will discuss these issues in more detail.

The alternative classification system to the DSM is provided by ICD-10. Within the ICD-10 classification system the category of Hyperkinetic Disorder is equated with the category of ADHD in DSM-IV. ICD-10 and DSM-IV have similar symptoms and diagnostic criteria for age of onset, duration, and situational pervasiveness. However impairment as a criterion does not formally appear in ICD-10, but must be inferred from the descriptions about the disorder. In ICD-10 the number of symptoms required for an ADHD diagnosis is not listed formally as it is in DSM-IV.

The subtype system in DSM-IV represents the major difference between the two classification systems. ICD-10 melds the three ADHD subtypes into a single subtype: Disturbance of Activity and Attention. The ICD-10 Hyperkinetic-

Conduct Disorder subtype is, in DSM-IV seen as two separate disorders occurring together (ADHD and CD) rather than as subtype of ADHD. In ICD-10 a diagnosis of Hyperkinetic Disorder takes precedence over a diagnosis of CD so as to permit this subtype diagnosis to be made.

1 . 3 Aetiology of ADHD

Several causes have been suggested for ADHD. Among these are genetic factors parent-family environmental factors, various chemical and biochemical factors, and brain dysfunction. Each of these factors is to be discussed in more detail, below.

1 . 3 . 1 Genetic factors

ADHD appears to be a highly familial disorder. Morrison and Stewart (1971) interviewed the parents of ADHD and control children and found that 20% of the parents of ADHD children compared with 5% of control parents had a retrospective diagnosis of ADHD. Cantwell (1972) produced similar results with 20% of ADHD children having an ADHD parent compared to only 2% of controls. Twin studies of the heritability of ADHD have suggested that the disorder has a strong genetic component (Gilger, Pennington, & DeFries, 1992; Hechtman, 1996). Studies by Goodman and Stevenson (1989), and Sherman, Iacono, and McGue (1997), using monozygotic and dizygotic twins found that genetic factors accounted for about 50% of the variance in the two dimensions of inattention and hyperactivity-impulsivity. To further exemplify these findings, other studies have found strong evidence of family aggregation of ADHD ((Biederman et al., 1992; Biederman, Faraone, Keenan, Knee, & Tsuang, 1990;

Biederman, Faraone, Keenan, Steingard, & Tsuang, 1991; Epstein et al., 2000; Levy, Hay, McStephen, Wood, & Waldman, 1997). For instance, Biederman et al. (1990, 1992) found that first degree relatives of ADHD children were at five times greater risk for ADHD compared with relatives of controls. Levy et al. (1997) found ADHD has an exceptionally high heritability compared with other behaviour disorders, and Todd et al. (2001) studied female twins and found distinct and heritable ADHD phenotypes.

In summary, with respect to the relationship between parent-family variables and ADHD it seems reasonable to suggest that genetic factors play an important role in the development of ADHD. However it should be noted that genetic factors do not necessarily lead to the full manifestation of ADHD, rather genetic factors may predispose certain individuals to greater susceptibility to develop ADHD behavioural characteristics. Clearly risk factors, either genetic or family-environmental can have an additive or cumulative effect on an individual that may lead to the development of an ADHD phenotype (Barkley, 1998a; Campbell, 2000).

1.3.2 Parent-family environmental factors

Parent-family environment risk factors have also been posited to play a central role in the development of ADHD. In the Dunedin longitudinal study (McGee, Williams, & Silva, 1984a, 1984b), ADHD was found to be associated with family factors such as maternal psychological health, marital problems, and poor family relationships. Biederman, Milberger, et al. (1995a), and Biederman, Wozniak, et al. (1995) found that high level of parental conflict, less family cohesion, and high levels of parental psychopathology were correlated with

ADHD. This finding was consistent with that of Goodman and Stevenson (1989) who found ADHD to be associated with maternal malaise, coldness to the child, and criticism of the child. Nigg and Hinshaw (1998) found that boys with ADHD were more likely than controls to have mothers with major depression and/or anxiety, and fathers with a childhood history of ADHD. Boys with ADHD and comorbid ADHD-ODD/CD have been found to have fathers with higher levels of neuroticism and excessive alcohol use than fathers of normal children (Gadow et al., 2000). Other studies have shown that parents of certain types of ADHD children have histories of higher rates of sociopathy than parents of control children (Cantwell, 1972; Morrison & Stewart, 1971). While genetic factors may account for this association, this can also be explained in terms of factors independent of genetic factors. From a transactional perspective it seems reasonable to posit that ADHD children learn ADHD behaviours from parents (Barkley, 1998a; Campbell & Ewing, 1990; Shaw & Bell, 1993). However, there is no evidence to suggest that parent behavioural characteristics per se are in any way responsible for the development of ADHD behaviour, rather parent factors may serve to facilitate pre-existing ADHD behaviours. In support of this contention, Goodman and Stevenson (1989) found parent-family factors accounted for less than 10% of the variance in ADHD.

1.3.3 Chemical and biochemical factors

It was first proposed by Feingold (1975) that ADHD may be due to intolerance or allergic reaction to food additives (artificial dyes and preservatives), and naturally occurring salicylates. However the evidence for this is weak (Boris & Mandel, 1994; Bradley & Golden, 2001; Goyette, Conners, Petti, & Curtis, 1978; Gross, Tofanelli, Snodgrass, & Butzirus, 1987; Harley, Matthews, & Eichman, 1978). ADHD has also been linked to high sugar intake (Smith, 1976), but well designed studies have demonstrated no evidence to support an association between ADHD and high sugar intake (Gross et al., 1987; Prinz, Roberts, & Hantman, 1980; Wolraich et al., 1994; Wolraich, Milich, Stumbo, & Schultz, 1985). Similarly the purported association between ADHD and high blood lead levels (David, 1974) has been qualified by other findings that found no evidence to support an association between ADHD and high blood lead levels (Fergusson, Fergusson, Horwood, & Kinzett, 1988; Needleman et al., 1979; Thomson et al., 1989).

There is strong evidence supporting the link between prenatal smoking and the risk of a child developing ADHD (Milberger, Biederman, Faraone, Chen, & Jones, 1996; Milberger, Biederman, Faraone, Guite, & Tsuang, 1997; Milberger, Biederman, Faraone, & Jones, 1998; Nichols & Chen, 1981). Longitudinal studies have shown associations for children between the ages of 5-14 for prenatal alcohol use and ADHD (Burns, 1991; Streissguth, Barr, Sampson, & Bookstein, 1994).

Studies of substance abuse (heroin and cocaine) have shown links between prenatal exposure and behavioural problems in children (Ornoy, Michailevskaya, Lukashov, Bar-Hamburger, & Harel, 1996; Richardson, Conroy, & Day, 1996). There is evidence that prenatal substance abuse (alcohol, smoking, drug use) is linked to ADHD, with children small for gestational age, premature and subsequently demonstrating early ADHD behaviours (Mick, Biederman, Faraone, Sayers, & Kleinman, 2002)

1.3.4 Brain dysfunction

The parallelism between deficits seen in prefrontal injury of both animals and humans and those manifested by ADHD children has spurred researchers to examine the presence of frontal lobe deficits in ADHD children.

EEG and galvanic skin response studies comparing ADHD and normal children have reported problematic arousal and attentional processes related to dysfunction of the pre-frontal region, the reticular activating system, and/or their interconnections (Barkley, 1998a; Hughes & John, 1999; Kuperman, Johnson, Arndt, Lingren, & Wolraich, 1996; Ross & Ross, 1982). One study (Hughes & John, 1999) reported that qualitative EEG studies have identified brain abnormalities in 30-60% of ADHD children.

The results for neuropsychological studies are inconclusive. Several studies have either found that ADHD children perform significantly worse than controls (Grodzinsky & Diamond, 1992; Seidman, Biederman, Weber, Hatch, & Faraone, 1997), or have failed to find systematic differences between ADHD children and controls across a range of measures (McGee, Williams, Moffit, & Anderson, 1989). Barkley, Grodzinsky, and DuPaul (1992) stated that research studies examining the neuropsychological functioning of ADHD children have found more generalised problems than specific frontal problems, and overall, the data is problematic and dependent upon sample type, size, and child age.

Several studies have also posited that ADHD children experience dysfunction in the regulatory system for motor functioning or arousal via a loop from the frontal regions to the striatum (Drewe, 1975; Heilman, Voeller, & Naidu, 1991; Luria, 1969; VerFaellie & Heilman, 1987). Research on cerebral regional blood flow (Lou, Hendrickson, & Bruhn, 1984; Lou, Hendrickson, Bruhn, Borner, &

Neilsen, 1989) has found that ADHD children demonstrated hypoperfusion (below normal levels of cerebral blood flow). Lou et al. (1989) also found interrupted cerebral blood flow to the striatum in different subtypes of ADHD children. Other studies have found differences between ADHD children and normal children in basal ganglia volume and size (Aylward, Reiss, Reader, & Singer, 1996; Castellanos et al., 1994; Fillipek et al., 1997).

Damage to the temporal lobe has also been associated with ADHD as reduced attention, overactivity, and cognitive deficits related to language development (Millichap, 1997). Parietal lobe damage has also been linked to ADHD as poor attention and memory skills, and spatial relations (Aman, Roberts, & Pennington, 1998; Epstein, Conners, Ernhardt, & March, 1997; Garcia-Sanchez, Estevez-Gonzales, Suarez-Romero, & Junque, 1997).

While the results of the above studies provide evidence of association between brain dysfunction and ADHD, most studies have focused on localised regions within the brain. There is a need for future studies to examine several cortical and subcortical regions together within a single study. This process is needed to establish whether there is a single unified aetiology of ADHD, or whether the underlying aetiology of ADHD is represented by different causal subtypes that account for differences in symptom presentation, treatment response, and comorbidity.

Finally, recent research (Castellanos & Tannock, 2002) has proposed that quantitative indices of disease liability or risk, termed endophenotypes, may predict the risk of ADHD in the same way that serum cholesterol predicts the risk of cardiovascular disease. These authors have proposed that three endophenotypes, a specific abnormality in reward-related circuitry leading to shortened delay gradients, deficits in temporal processing, and deficits in working memory may be related to the aetiology of ADHD.

In summary, there is general agreement that a mixture of biologic-genetic, family environment, and community factors interact to lead to variations in age-of-onset of problems, symptom expression and severity, comorbidity, developmental course, and response to treatment (Barkley, 1998c; Campbell, 2000; Cantwell, 1996; Hinshaw, 1994; Ross & Ross, 1982). For instance, some ADHD children having varying degrees of aggression, noncompliance, poor impulse control, and overactivity when very young, may simply outgrow their problems. In particular, when the behaviours of such children occur at only moderate levels of severity, and they have supportive and well-functioning families, ADHD problems are less likely to persist, and in retrospect such problems may be seen as a transient developmental phase (Campbell, 1997).

1 . 4 Prevalence and gender ratios

Prevalence rates for ADHD have varied widely based on geographical location, different country, age range of the children, the definition of ADHD being used, how ADHD was being measured, and who was reporting the symptoms. It appears that the move to DSM-IV and the inclusion of three subtypes, two with somewhat lower thresholds, has led to a slight increase in prevalence over earlier prevalence rates based on DSM-III and DSM-III-R (Wolraich, Hannah, Pinnock, Baumgaertel, & Brown, 1996). Based on well-conducted epidemiological studies rates have varied widely ranging between 1%-9% (see review by Bird, Gould, & Staghezza, 1993). DSM-IV (APA, 1994, p. 82) estimates prevalence between 3% and 5% depending on sample type (normative or clinic). Statistics from the Australian National Mental Health Survey have indicated prevalence rates of 11.2% for ADHD (Sawyer, Arney, & Baghurst, 2001).

The prevalence rates and gender ratios for the three ADHD subtypes are not provided in DSM-IV. Based on teacher ratings of a community sample Baumgaertel, Wolraich, and Dietrich (1995), reported an overall rate of 17.7% for ADHD, with rates of 9%, 3.9%, and 4.8% for the inattention, hyperactive-impulsive, and combined subtypes respectively. The overall rate reported by Wolraich et al. (1996) was 11.4%, with 5.4%, 2.4%, and 3.6% for the inattentive, hyperactive-impulsive, and combined subtypes respectively. Based on teacher and parent agreement, Gomez, Harvey, Quick, Scharer, and Harris (1999), found prevalence rates to be 1.6%, 0.2%, and 0.6% for inattention, hyperactivity-impulsivity, and combined subtypes, respectively.

In summary it seems that prevalence rates may vary (Wolraich et al., 1996, Wolraich, Feurer, Hannah, Baumgaertel, & Pinnock, 1998) depending on whether they reflect school samples or community samples, and how they have been identified. In addition, there is also evidence that ADHD prevalence rates diminish with age. Based on a review of nine prospective follow-up studies, the rates of ADHD in a given age group appear to decline by 50% approximately every five years leading to estimates of adult ADHD at 0.8% at age 20, and 0.5% at age 40 (Hill & Schoener, 1996).

Studies indicate that ADHD is more prevalent in boys than girls (Anderson, Williams, McGee, & Silva, 1987; Cohen, Cohen, Kasen, & Veles, 1993; Szatmari, Offord, & Boyle, 1989; Wolraich et al., 1996). Gender differences appear to be especially strong when teacher reports are used to define ADHD

(Campbell, 2000). DSM-IV estimates gender ratios at from 4:1 to 9:1 (APA, 1994, p. 82). Gender ratios have been reported to be higher in younger than older children (Cohen et al., 1993; Offord et al., 1987). More recent evidence suggests that girls have been under-represented in past research. Data from DSM-IV field trials and other recent studies has indicated that the DSM-IV inattentive subtype may lead to the inclusion of more girls in future research on ADHD (Lahey et al., 1994; Wolraich et al., 1996). A recent meta-analysis (Gaub & Carlson, 1997b) has indicated that girls are more likely to be the ADHD-IA subtype than the ADHD-H/I subtype, and hence in the future more girls are likely to be identified than under the two previous diagnostic systems.

1 . 5 Prognosis and outcome

Overall 30% to 80% of diagnosed ADHD children continue to have features of ADHD persisting into adolescence, and up to 65% into adulthood (Barkley, 1998c; Weiss & Hechtman, 1993). Klein and Mannuzza (1991) reported that fewer than 10% of adults who had an ADHD only diagnosis at age 10 will receive an ADHD diagnosis at age 25. A family history of ADHD, psychosocial adversity, and comorbidity with ODD and CD, mood and anxiety disorders, increase the risk of persistence of ADHD symptoms (Biederman et al., 1995b). Delinquent behaviour or antisocial personality is seen on adolescent or adult follow-up in as many as 25% to 40% of clinically referred ADHD children, especially boys with early conduct problems (Barkley, McMurray, et al., 1990; Gittelman, Mannuzza, Schenker, & Bonagura, 1985; Weiss & Hechtman, 1993). Defiance toward adults and hostile aggression are particularly poor prognostic indicators (Abikoff & Klein, 1992; Fischer, Barkley, Fletcher, & Smallish, 1993;

Loney & Milich, 1981; Satterfield, Swanson, Schell, & Lee, 1994). Most studies have found that antisocial behaviour in later life is rare without early conduct problems. The early conduct problems of some ADHD children appear to lessen in adolescence or adulthood (Herrero, Hechtman, & Weiss, 1994).

Children with ADHD appear more likely than normal children to experiment with substance drugs, alcohol, and to use cigarettes in adolescence (Barkley, DuPaul, et al., 1990; Lambert, 1988; Mannuzza et al., 1991). However, one large longitudinal community study found the association between childhood ADHD and adolescent use of tobacco, alcohol, and illicit drugs was attributable only to CD rather than ADHD at 8 years of age (Lynskey & Fergusson, 1995). Specific predictors of poor prognosis include adult-directed oppositional and aggressive behaviours, low IQ, poor peer relations, and continuing ADHD (Hechtman, 1996). The presence of comorbid CD in ADHD children, or the presence of ODD in ADHD children, has been shown to increase the risk for later development of CD (Farrington, Loeber, & Van Kammen, 1989). Finally, although girls have been studied much less than boys, limited data have suggested similar outcomes (Klein & Mannuzza, 1991).

With respect to the DSM-IV ADHD subtypes, existing research has shown that the ADHD combined and hyperactive-impulsive subtypes have a worse prognosis than the ADHD inattentive subtype. To date, most studies have failed to consistently differentiate beween the combined and hyperactive-impulsive subtypes for ODD and CD symptoms, aggression, delinquency, school and home behavioural problems, and peer relations (Faraone et al., 1998; Gaub & Carlson, 1997a; Lahey et al., 1998; Nolan, Gadow, & Sprafkin, 2001; Paternite, Loney, & Roberts, 1996; Teegarden & Burns, 1999; Wolraich et al., 1996).Therefore while it is clear that the dimension of inattention per se is less associated with adverse outcomes, the data is inconclusive as to the contribution of the dimension of hyperactivity-impulsivity, either separately, or in combination with the inattention dimension as applies with the ADHD combined subtype in DSM-IV.

1 . 6 Treatment of ADHD

At present the most common approaches to treatment of ADHD are either medical interventions, psychosocial interventions (ie., behavioural treatment, cognitive-behavioural treatment),or a multimodal approach combining medication and behavioural or cognitive-behavioural interventions. The following will provide a review of each of these approaches.

1 . 6 . 1 Medical interventions

Psychostimulants (dexamphetamine, methylphenidate, and pemoline) are the most common and effective medications for ADHD. Studies reviewed by Barkley (1990) showed that about 75% of ADHD children respond to either dextroamphetamine or methylphenidate.

Dosage rates are usually based on child age and weight, and depending on ADHD type and severity of disorder, they range between 0.3 mg/kg to 1.0 mg/kg per dose. Initially it was thought that there was a linear relationship between dose and behavioural improvement, however it is now believed that response is highly idiosyncratic and influenced by physiological and/or environmental factors (Pliszka, Carlson, & Swanson, 1999).

In general, psychostimulants have been found to improve the cognitive functioning of ADHD children (Douglas, Barr, Amin, O'Neill, & Britton, 1988;

Krusch et al., 1996; Losier, McGrath, & Klein, 1996; Milich, Licht, Murphy, & Pelham, 1989). Short term use of psychostimulants has resulted in marked improvement in classsroom behaviour, attention, academic tasks, and persistence and effort (Benedetto & Tannock, 1999; Cantwell, 1980; Carlson & Bunner, 1993; Famularo & Fenton, 1987; Klorman, Coons, & Borgstedt, 1987; Pelham & Murphy, 1986; Pelham, Swanson, Furman, & Schwindt, 1995; Rapport, Denney, DuPaul, & Gardner, 1994; Rugino & Copley, 2001).

Social behaviour, including peer interactions, has also been shown to improve considerably with the use of psychostimulants. In particular, overt externalising behaviours that may be related to the later development of ODD and/or CD, may be considerably diminished with use of psychostimulants (Hinshaw, Henker, Whalen, Erhardt, & Dunnington, 1989; Hinshaw & McHale, 1991; Pelham & Bender, 1982).

However it should also be noted that many studies have shown marked variation in children's response to stimulants. Based on this, researchers and clinicians are increasingly recognising that the use of medication should be based on the different subtypes of ADHD, the different physical characteristics of each child, and the different comorbidities involved (Barkley, 1998a; Levine, 1987; Schachar & Ickowicz, 1999). For instance, ADHD children with more severe behavioural disturbances, aggression, and social information processing problems appear to respond less well to medication than ADHD children with more benign conditions (Schachar & Ickowicz, 1999). ADHD children with anxiety disorders also do not appear to respond well to psychostimulants (Pliszka et al., 1999; Tannock, Ickowicz, & Schachar, 1995; Swanson, Kinsbourne, Roberts, & Zucker, 1978; Vance & Luk, 1998; Zahn, Abate, Little, & Wender, 1975). While there is no evidence that psychostimulants generate dependency effects (Hechtman, 1985; Schachar, Tannock, Cunningham, & Corkum, 1997) up to 30% of children do not respond well to psychostimulants and may have some untoward side effects (Pliszka et al., 1999).

Apart from psychostimulants as the first-line medication for ADHD children, tricyclic antidepressants have been shown to be reasonably effective for treatment of comorbidity between ADHD and mood and anxiety disorders (Pliszka et al., 1999; Prince, Wilens, Biederman, Spencer, & Wozniak, 1996). New age antidepressants such as the selective serotonin reuptake inhibitors (SSRI's) have not yet been widely studied. Preliminary evidence indicates positive effects upon mood disorders with fewer side effects, but there appears to be less effect on attention processes (Barrickman, Noyes, Kuperman, Schumacher, & Verda, 1991; Gammon & Brown, 1993). Similar preliminary evidence has indicated that antihypertensives (clonidine) may be a useful second line approach for those ADHD children with heightened hyperactivity-impulsivity and aggression (Hunt, 1987; Hunt, Minderaa, & Cohen, 1985, 1986), but without depressive symptoms or a family history of mood disorders (Hunt, Capper, & O'Connell, 1990).

There have been several objections to the use of medication in treating ADHD (Gadow, 1988). There has been evidence that medication can cause side effects, such as sleeplessness, drowsiness, dizziness, irritability, appetite loss, tics, growth impairment, hallucinations, mood change, head-aches and stomach-aches (Barkley, McMurray, Edelbrock, & Robbins, 1990; Cantwell, 1975; Waltonen, Olson, Theye, Van Erem, & LaPlant, 1993).

Other studies have disputed some of the above findings. Concerns that methylphenidate can cause growth impairment have been considerably allayed by the results of long-term studies that have not supported the growth impairment argument (Goldstein & Goldstein, 1990; Spencer et al., 1996). For the relation between tics and psychostimulants studies have shown that the situation is inconclusive (Gadow, Nolan, Sprafkin, & Sverd, 1995). Headaches and stomachaches have been shown to dramatically reduce if dosage level and dosage time is closely monitored (Swanson, Sandman, Deutsch, & Baren, 1983; Schachar et al., 1997). While appetite loss is a concern, Schachar and Ickowicz (1999) have indicated that flexible management and flexible dosage rates and dose timing can substantially minimise this problem.

The stability of the relations between mood problems and ADHD has been questioned by the finding that mood change is not evident when medicated ADHD children are observed at play (Hinshaw, Buhrmeister, & Heller, 1989). In addition, other findings demonstrated that many children experienced reduced irritability and mood lability when taking psychostimulants (Ahmann et al., 1993; Klorman, Brumaghim, Fitzpatrick, Borgstedt, & Strauss, 1994).

There have also been concerns expressed that medication could encourage parents, teachers, and ADHD children themselves to attribute ADHD to factors outside their direct influence and thus beyond their control (Borden & Brown, 1989; Whalen & Henker, 1976; Whalen, Henker, & Hinshaw, 1985). Conversely, other researchers have suggested that the behavioural successes that attend psychostimulant treatment may have positive attributional outcomes (Milich, Carlson, Pelham, & Licht, 1991). The long-term effect of psychostimulants has not been well investigated. Schachar and Tannock (1993) evaluated 11 well-controlled trials that involved treatment of longer than 3 months duration. Data indicated that prolonged medication consistently improved core behaviour symptoms of ADHD. Generally ADHD children with only inattention problems required a lower dosage rate, whereas ADHD children with hyperactivity-impulsivity required higher dosage, and higher dosage was associated with greater behavioural change. However, the evaluation of these trials provided little evidence of benefits of psychostimulants on academic achievement, conduct problems peer relations or self-esteem.

In summary, several researchers have suggested that ADHD children may be highly idiosyncratic in their response to medication as a function of environmental contingencies (especially parent and school variables) and individual physiology and personality (Barkley, 1990; Forness, Swanson, & Cantwell, 1992; Smith, Pelham, Gnagy, & Yudell, 1998). There is a growing recognition that response to medication may be governed by such variables as comorbidity, dose level, dose time, child's age, size, IQ, mood state, tiredness or arousal, motivation, and external variables such as parental discipline, parenting style, and overall quality of parent-child and family relationships.

1 . 6 . 2 Psychosocial interventions

Psychosocial interventions such as behavioural modification, and cognitive therapies including child social skills training and anger management programs, together with parent training programs have been investigated as possible adjuncts to medication regimes. The following will include a review of studies that have examined behavioural, cognitive-behavioural, and multimodal treatments.

1.6.2.1 Behavioural treatments

Several reviews have concluded that behavioural interventions particularly those involving the direct application of both positive reinforcement and response cost contingencies in classroom settings are effective in the treatment of ADHD (DuPaul & Eckert, 1997; Mash & Daiby, 1979; Prout, 1977). Several studies have shown response cost contingency management programs to be highly efficacious in increasing on-task behaviour and academic productivity (Barkley, 1989; Hinshaw & Erhardt, 1990; Rapport, 1987; Zentall, 1985, 1989). However other studies have produced conflicting data. Some studies have failed to show the adequacy of behavioural treatments (Abikoff & Gittelman, 1984; Pelham & Murphy, 1986, Rapport, 1987), or have shown that the effect of behavioural contingencies do not persist once the treatment is discontinued (Hinshaw & Erhardt, 1990). This suggests that the external contingencies of behavioural treatments do not necessarily provide the means for the child to internalise and understand his/her behaviour so that long-term behavioural change can occur.

1.6.2.2 Cognitive-behavioural treatments

Cognitive-behavioural treatments focus on the relations between problem solving and anticipation of the consequences of actions. Cognitive-behavioural treatments with mild-moderate ADHD children have been reasonably successful (Braswell & Bloomquist, 1991). By contrast, the data for more severely behaviourally disturbed ADHD children have produced conflicting results.

Abikoff (1985, 1987, 1991), reviewed several studies and concluded that cognitive-behavioural training was ineffective. Other studies have been remarkably consistent in showing that cognitive behavioural interventions have limited clinical utility upon behaviour and academic performance (Bloomquist, August, Cohen, Doyle, & Everhart, 1997; Brown, Borden, Wynne, Spunt, & Clingerman, 1987). Pelham and Waschbusch (1999), while questioning Abikoff's findings, have suggested that the efficacy of cognitive behavioural programs is improved when used in conjunction with other therapies. They have claimed that the studies reviewed by Abikoff above contained mostly comorbid ADHD-ODD/CD children, and not ADHD only children. In support of their assertion, when cognitive therapies have been used in adjunct with social skills training (Pelham & Hoza, 1996; Pfiffner & McBurnett, 1997), anger management (Hinshaw & Erhardt, 1991), and parent training (Kazdin, 1996; Lochman & Lenhart, 1993) there appears to be beneficial effects.

Other studies have shown that interventions with children alone have had limited success, but the inclusion of teacher and parents within the programs has resulted in significant improvement on different cognitive measures after program completion and at 3 month follow-up (Douglas, Parry, Marton, & Garson, 1976, Kirby & Grimley, 1986). Indeed, approaches that have emphasised the central role of parents and family in program implementation have been found to be the most effective of all cognitive-behavioural therapies (Braswell & Bloomquist, 1991). Studies across cultures have shown a family systems approach to be highly effective for management of ADHD (Kendall, 1991; van der Vlugt, Pijnenburg, Wels, & Koning., 1995). In addition, cognitive-behavioural self-control training can reduce the negative effects of hyperactivity-impulsivity but the results for hyperactive-impulsive children with comorbid aggression are not as consistent as those for non-aggressive ADHD children (Lochman, 1992; Miranda & Presentacion, 2000).

Overall, problems with design and methodology, especially failure to screen for comorbidity of aggression and conduct problems, and minimising the role of parents and teachers, have compromised the effects of behavioural, and cognitive-behavioural treatments. In addition, to date the relation between behavioural setting, age of subject, and type of disorder, has been understudied. The available data has suggested a need for future interventions to include maintenance programs to improve likelihood of program success (DuPaul & Eckert, 1997).

1 . 6 . 2 . 3 Multimodal treatments

Considering the strengths and limitations of medical, behavioural, and cognitive-behavioural interventions it is clear that no one form of intervention is adequate for the needs of most ADHD children. Studies have concluded that multimodal treatments (medication and psychosocial therapy) provide the optimal treatment condition (Satterfield, Cantwell, & Satterfield, 1979; Satterfield, Satterfield, & Schell, 1987). In particular, the Multimodal Treatment Study of Children with ADHD (MTA) demonstrated that combined treatments allow the use of lower medication dosage, and multimodal treatments are more effective for comorbid symptoms (Levy, 2001).

There are a number of advantages of combined behavioural and pharmacologic treatments of ADHD. The level of both components can be reduced when a multimodal approach is used (Atkins, Pelham, & White, 1989), and cost effectiveness of treatment can be considerably enhanced (Pelham &

Waschbusch, 1999). Multimodal treatments often have complementary effects such as reduced medication frequency and dosage rates, increased child self-monitoring, and improved teacher and parent understanding and skill in dealing with ADHD children (Carlson, Pelham, Milich, & Dixon, 1992; Hinshaw et al., 1989; Hinshaw, Heller, & McHale, 1992; Pelham, Bender, Caddell, Booth, & Moorer, 1985; Pelham & Murphy, 1986). The strength of multimodal treatments appears based on the fact that ADHD as a disorder seems to have intrinsic (biological) and extrinsic (psychosocial) components, and hence both these components need to be addressed to treat the disorder.

Nevertheless there are some qualifications to the existing multimodal findings. To date, very few children have been treated with such programs, the method in most of these programs is limited by single-subject design, and there is very little evidence for the longer term effects of such programs (Pelham & Waschbusch, 1999). Finally, it has also been shown that the incremental benefit of combined treatments does not last after either component is withdrawn (Pelham et al., 1985).

1 . 7 Theories of ADHD

The major theories associated with ADHD that are to be discussed in this section are as follows: defective mental control (Still, 1902); minimal brain dysfunction (Wender, 1971); information processing theory and its associated energetic model (Sergeant, 1995a, 1995b)); self-regulation theory with impaired cognitive processing and motor control as the central deficits associated with behavioural problems (Douglas, 1980, 1983; Douglas & Peters, 1979); the underfunctioning of the brains's behavioural inhibition system (Quay, 1988a, 1988b, 1996) and an overarching theory of behavioural inhibition related to executive functioning (Barkley, 1994, 1997).

Still (1902) posited a theory for young children with problem behaviour based on the notion of defective moral control as a function of hierarchical relations between three distinct impairments: (a) defect of cognitive relation to the environment, (b) defect of moral consciousness, (c) defect in inhibitory volition. Central to Still's theory was the prominent role of poor inhibition, poor sustained attention, and hyperactivity, and he carefully distinguished these constructs in terms of moral impairments that differentiated children on the basis of general cognitive delay.

Seventy years later Wender (1971) described the essential psychological characteristics of children with minimal brain dysfunction (MBD) as comprising six clusters of symptoms: (1) motor behaviour, (2) attentional and perceptual cognitive functioning, (3) learning difficulties, (4) impulse control, (5) interpersonal relations, and (6) emotion. Wender theorised that within these 6 domains of dysfunction there were three primary deficits: (1) a decreased experience of pleasure and pain, (2) a generally high and poorly modulated level of activation, and (3) extroversion (Wender, 1971). A consequence of poor motor behaviour is that MBD children would prove less sensitive to both rewards and punishments, making them less sensitive to social influence. The poor activation component was in turn related to poor inhibition, and hyperactivity was posited to be the primary manifestation of high levels of activation. Attention and distractibility problems were perceived to be a secondary aspect of high activation (Barkley, 1999).

Contemporary with Wender's research, Douglas and colleagues (1972, 1976,1979, 1980, 1983, 1988) conducted a series of studies that gradually evolved into a theory about ADHD. The theory proposed defective self-regulation as an umbrella construct to represent four separate domains of problematic functioning: (1) poor investment and maintenance of effort, (2) deficient modulation of arousal to meet situational demands, (3) strong inclination to seek immediate reinforcement, along with (4) the originally proposed difficulties with impulse control. Douglas also proposed that difficulties with effort allocation and poor intrinsic motivation characterised the performance of ADHD children with the result that greater task effort was related to greater deficit in task performance in comparison to normal children. (Douglas, 1972; Douglas & Benezra, 1990; Douglas & Parry, 1983; Douglas & Peters, 1979).

Based on the work of Eysenck (1967), as well as animal pharmacology, and lesion studies, Gray (1975, 1982, 1987) proposed two orthogonal dimensions of personality: anxiety and impulsivity. These dimensions were hypothesised to represent two distinct neuropsychological systems that differed in their sensitivity to reward and punishment. Based on this, Gray developed a theory of brain function characterised by two different but interacting behavioural systems, the Behavioural Activating System (BAS), and the Behavioural Inhibition System (BIS). He also stipulated mechanisms for basic nonspecific arousal, and for the appraisal of incoming information that must be critical elements of any attempt to model the emotional functions of the brain.

Gray suggested that the BIS is involved in regulating aversive motivation, and it responds to signals of aversive stimuli, such as punishment, frustration, non-reward, and novel and unexpected events. When activated the BIS inhibits behaviours that can lead to negative outcomes (Avila, 2001; Daugherty & Quay, 1993). By contrast, the BAS is involved in regulating appetitive motivation, and it responds to signals of reward and non-punishment, resulting in heightened arousal, approach and active avoidance behaviour (Fowles, 1980).

Quay (1988a, 1988b, 1993) has adapted the work of Gray and another researcher Newman (1987) who had researched the role of disinhibition in the behaviour of adult psychopaths. In relation to ADHD, Quay hypothesised that the impulsivity characterising the disorder arises from diminished activity in the BIS, expressed as low responsivity to punishment cues irrespective of the presence or absence of reward cues. Much of Quay's work has focused on differentiating between ADHD and CD, in terms of differences in BAS and BIS functioning. Thus, given the assumed similarities between disinhibited behaviour in children with ADHD and those with CD it could be assumed that ADHD is also characterised by BAS dominance. Despite this quite plausible connection, Quay (1988a, 1988b), and Daugherty and Quay (1991), have in fact suggested a dysfunctional BIS as being responsible for impulsive behaviour in ADHD children. Whereas CD and antisocial behaviour may be associated with a dominant BAS that is particularly sensitive to reward cues in situations involving both reward and punishment, ADHD may reflect a deficient inhibitory system in impulsive behaviour regardless of the presence of reward cues. Therefore, the relatively greater impairment in functioning of comorbid ADHD-CD children, as opposed to impairment in either separate disorder, may be due to an overactive BAS in combination with a dysfunctional or maladaptive BIS (Milich, Hartung, Martin, & Haigler, 1994; Schachar, Tannock, & Logan, 1990; Shapiro, Quay, Hogan, & Schwartz, 1988).

While the findings in the above and other studies (Fonseca & Yule, 1995; Jennings, van der Molen, Pelham, Brock-Debski, & Hoza, 1997; O'Brien & Frick, 1996) are consistent with Quay's model that CD is characterised by a dominant BAS, other research has not been consistent with Quay's model with regard to ADHD. The findings in this research has implied that ADHD children's impulsivity may be related to a generalised deficit that is independent of different reinforcement conditions (Iaboni, Douglas, & Baker, 1995; Milich et al., 1994; Oosterlaan & Sergeant, 1998).

A somewhat different view of inhibitory failure, and one more closely aligned to cognition than conditioning models, is the race model (Logan, Cowan, & Davis, 1984) and the stop signal paradigm used to test its predictions (Chee, Logan, Schachar, Lindsay, & Wachsmuth, 1989; Schachar et al., 1993). Schachar and Logan (1990) have explained the disinhibition responses of ADHD children in terms of inefficient information processing. According to this model, the processing of information to stop a current response when signalled does not occur quickly enough to inhibit the current response (race model). Conceptually, the two processes are independent and their relative speeds determine the outcome. Results from this research have shown that ADHD children have deficits in inhibitory control but not in attentional resources (Logan et al., 1984; Schachar et al., 1993; Schachar, Tannock, Marriott, & Logan, 1995; Tannock, Schachar, Carr, Chajczyk, & Logan, 1989). Importantly, the deficits appear more pronounced in ADHD children with more pervasive behaviour problems (i.e., ADHD-C and H/I subtypes) than less pervasive behaviour problems (i.e., inattentive subtype).

Sergeant and van der Meere (1988, 1990a, 1990b) have questioned whether relations between the stop-signal and response choice require the same control processes. By using information processing theory, and its associated energetic model (arousal, activation, and effort) they have likened the poor response inhibition of ADHD children to differences in motor preparation arising from a non-optimal activation state. Their studies have shown that the attentional difficulties of ADHD children on purportedly simple vigilance tasks are mainly attributable to strategic factors and effort allocation on the output side rather than to the central stages of search and decision. Given that these differences are heightened at slow event rates (van der Meere, Vreeling, & Sergeant, 1992) it has thereby been contended that attentional processes deficits are not centrally involved. In addition, their studies showed that, after making errors on challenging tasks that normal children tend to slow down, whereas ADHD children fail to adjust their response speed. In essence, this theory has highlighted that ADHD children's problems are defined by a failure to bring resources to bear on information processing (Oosterlaan & Sergeant, 1995; Sonuga-Barke, 1995; Sergeant & van der Meere, 1988; van der Meere et al., 1992).

Barkley (1994, 1997) has provided the most unified theory of ADHD. Barkley has combined into a new model, Bronowski's theory of the unique qualities of the human language that arose from the pre-frontal cortex (Bronowski, 1977), in association with a theory of prefrontal functions on the neuropsychological factors subserved by the pre-frontal cortex (Fuster, 1989; 1995). Barkley has proposed a model in which a delay in normal development can lead to impaired impulse control. This new model was based on (a) the inclusion of more precise definitions of behavioural inhibition and self-regulation, (b) the addition of a motor-control-fluency-syntax component to the model, (c) the reconfiguration of the model components more logically than before, (d) the addition of numerous recent findings relating to associations between these components and their applicability to ADHD, and (e) additional predictions about ADHD (Barkley, 1997).

Barkley's model posits behavioural inhibition as being related to four distinct, internal executive functioning domains: (1) working memory, especially temporal factors, (2) self-regulation of affect/motivation/arousal, (3) internalisation of speech including information processing and rule-governed behaviour, (d) reconstitution which includes understanding, analysis, and integration of behaviour. These 4 domains are in turn separately related to motor control, and it is at this level that the behavioural performance occurs. Within Barkley's model, behavioural inhibition does not directly cause the four executive functions, but merely sets the occasion for their performance (Barkley, 1997), however an abundance of research studies have shown that each of the four executive functioning domains do separately produce direct or causal effects on motor performance (Castellanos et al., 1994, 1996; Fuster, 1989, 1995; Goldman-Rakic, 1995; Milner, 1995). Attesting to the strength of the model, Barkley (1997) stated that it provided a linkage between response inhibition and the four executive functions that depend on such inhibition for their own effective performance.

1 . 7 . 1 Summary of theories of ADHD

The preceding review of the different theories has suggested that response disinhibiton related to impulsivity is the most popular explanation for ADHD. Although Barkley's theory is extremely comprehensive, Whalen and Henker (1997) have indicated that the view that one overarching construct, even one so broad as inhibitory failure, can explain the complexity of ADHD is probably unrealistic. Moreover, as previously discussed in this chapter in the subsection reviewing possible aetiologies for ADHD, unified theories such as Barkley's need to be further tested by neurophysiological studies related to deficiencies in the development, structure, and function of the frontal and pre-frontal cortex and their associated networks with other brain regions especially the striatum.

1. 8 Major comorbid disorders

ADHD is commonly regarded as the most common neurobehavioural disorder of childhood, and is also among the most prevalent health conditions affecting school-age children (Campbell, 2000). ADHD commonly occurs in association with ODD, CD, depression, anxiety, and many developmental disorders such as learning disorders including speech, language, and communication disorders.

Research studies have consistently shown that a large percentage of ADHD children will also have a learning disorder (Dykman & Ackerman, 1991; Frick et al., 1991; Holborow & Berry, 1986; Livingston, Dykman, & Ackerman, 1990; McGee, et al., 1984a, 1984b; Semrud-Clikeman et al., 1992). Barkley (1990), Frick et al. (1991), and Semrud-Clikeman et al. (1992) have referred to IQ discrepancies between ADHD and normal children, and indicated that learning disorders for reading, spelling, and arithmetic is higher in ADHD children than controls. Overall, studies suggest that as many as 50% - 60% of ADHD children have learning disorders related to speech, language and formal academic areas. Particularly disturbing are findings that the academic skills of ADHD children are impaired even before their first grade at school (Mariani & Barkley, 1997). Results are mixed as to which of the core symptoms of ADHD (i.e., inattention or hyperactivity-impulsivity) are more associated with specific type of learning disability (Berry, Shaywitz, & Shaywitz, 1985; Carlson, Lahey, & Neeper, 1986; Casey, Rourke, & DelDotto, 1996; Gaub & Carlson, 1997a; Hynd et al., 1991).

Epidemiological and clinical studies consistently show that approximately 50% of ADHD children (mostly boys) will meet the criteria for ODD or CD (Bird et al., 1993; McGee et al., 1984a, 1984b; Milich, Widiger, & Landau, 1987; Reeves, Werry, Elkind, & Zametkin, 1987). Hinshaw (1987) reviewed approximately 60 factor analysis studies through 1969-1986 and found that 41 studies yielded evidence of two separate but highly correlated factors. The first factor comprised mainly cognitive deficits, and it was proximal to ADD in DSM-III. The second factor comprised aggression, conduct problems and social adversity and inconsistent parenting, and it was proximal to what we now term as ODD/CD. Later studies (Pelham, Evans, Gnagy, & Greenslade, 1992; Pelham, Gnagy, Greenslade, & Milich, 1992), using DSM-III-R symptom lists found a strong overlap between ADHD and ODD/CD. It has also been suggested that ADHD, ODD, and CD may fall along the continuum of increased levels of familial and aetiological factors (Biederman et al., 1991; Faraone, Biederman, Keenan, & Tsuang, 1991). These authors concluded that it is the pervasiveness and persistence of certain ADHD behaviours rather than merely a specific

ADHD condition that is the principal determinant for the development of ODD and later developmental antisocial behaviours including CD.

Szatmari et al. (1989) demonstrated that comorbid ADHD-ODD/CD children had worse outcomes than either "pure" ADHD or ODD/CD children due to the association between developmental disorder (ADHD) and psychosocial dysfunction (ODD/CD). Other researchers have suggested that the core ADHD feature of impulsivity may be a central ODD/CD marker, and acts as a developmental facilitator between ADHD and ODD/CD (Barkley, 1990; Halperin, O'Brien, & Newcorn, 1990), or that ADHD and ODD/CD may be genetically linked (Comings, 1997). Supporting this notion, Faraone, Biederman, and Monuteaux (2000) found that relatives of ADHD only children were not only at greater risk for ADHD, but were also at greater risk for ODD than relatives of control subjects.

Normative and clinic samples have consistently found the comorbidity between ADHD and anxiety to be between 20%-30% (Anderson, Williams, McGee, & Silva, 1987; Biederman et al., 1991, 1992; Bird et al., 1993; Pliszka, 1989). The Multimodality Treatment Study of ADHD (Arnold et al., 1997) found that 34% of children with ADHD met criteria for an anxiety disorder. However despite this data, several studies have indicated that disorders with internalising symptoms such as anxiety and depression are underreported and under diagnosed (Jensen, Shervette, Xenakis, & Richters, 1993; Piacentini et al., 1993; Schwab-Stone et al., 1993). Pliszka et al. (1999) suggested that this may be due to parent denial, clinical failings, and confusion over what constitutes an internalising disorder in younger children. With respect to family aggregation, the rate of anxiety disorders was found to be elevated only in the relatives of ADHD anxiety children, and not in the relatives of ADHD only children (Biederman et al., 1991, 1992; Epstein et al., 2000). Pliszka et al. (1999) commented that these findings were consistent with the notion that ADHD and anxiety were separate disorders inherited independently of each other.

Children with ADHD experience more depression than children without ADHD (Willcutt, Pennington, Chhabildas, Friedman, & Alexander, 1999). As many as 20% of ADHD children develop depression or a similar mood disorder by early adulthood (Jensen, Martin, & Cantwell, 1997). Biederman et al. (1991, 1992) demonstrated that relatives of ADHD only children had an increased risk for ADHD and depression. These researchers together with Mannuzza et al. (1991) have suggested that ADHD and depression share some common but as yet unknown genetic mechanism. Studies have shown that the association between ADHD and depression (especially maternal depression) may be mediated by family risk factors such as low IQ, low education, socioeconomic disadvantage, and parent-child conflict related to parent psychopathology or inconsistent or rejecting parenting (Biederman, Wozniak, et al., 1995; Carlson, Jacobvitz, & Sroufe, 1995; Johnston, Murray, Hinshaw, Pelham, & Hoza, 2002; Mash & Johnston, 1983; Stormont-Spurgin & Zentall, 1995; 1996).

1. 9 Conclusions

ADHD is characterised by three core deficits related to attention, hyperactivity, and impulsivity. Although many past studies have regarded ADHD children as a relatively homogeneous group, it is clear from the comorbidity between ADHD and ODD/CD, anxiety and mood disorders, and learning disorders, that ADHD children belong to an extremely heterogeneous group.

Multiple aetiological pathways have been suggested for ADHD, and variations in age-of-onset, symptomatology, developmental course, and response to treatment, serve as a direct expression of the heterogeneity of the disorder. In terms of treatment, psychostimulants represent the optimal medication for most ADHD children, and with respect to treatment outcomes it is clear that among the different approaches, a multimodal approach (medication plus behavioural/cognitive therapy) represents the most effective treatment option.

Various theories, primarily relating to deficits in executive processing as a function of response disinhibition or deficient information processing have been posited to explain the behavioural characteristics of ADHD children. In particular, one researcher has proposed a model in which the global and neuropsychological deficits of ADHD children, are explained in terms of an increased understanding of neurophysiology, especially the workings of the frontal and pre-frontal cortex.

In summary, this chapter has provided a brief review of the theories, and aetiologies for ADHD, and other major factors that identify and characterise the course and outcomes of ADHD. Studies have universally identified the three core dimensions of the disorder to be inattention, hyperactivity, and impulsivity. The next chapter will examine the relationship between the 3 core ADHD dimensions, and how the symptoms within these core dimensions have been organised for the diagnosis of ADHD over the last two decades.

CHAPTER 2

OVERVIEW OF THE CONCEPTUALISATION AND DIAGNOSIS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER

2 . 1 Introduction

ADHD is one of the most common childhood disorders. The current edition of the Diagnostic and Statistical Manual of Mental Disorders (APA, 1994) suggests that the core symptoms of the disorder are inattention, hyperactivity, and impulsivity.

Over the past 30 years there has been a great deal of research examining the aetiology and characteristics of the disorder. An examination of different editions of the DSM (APA, 1968, 1980, 1987, 1994) will show that no other childhood psychopathology has undergone as much renaming and reconceptualisation as this disorder (Lahey et al., 1988).

The history of ADHD can be divided into several periods, during which there has been generally a slow but progressive movement toward greater diagnostic efficiency and utility. Thus, a thorough understanding of the present conceptualisation of ADHD is contingent upon a detailed examination of the changes in our understanding of the disorder.

The aim of this chapter is to provide a brief critical historical overview of our understanding of the core features of this disorder. This chapter will show that throughout the last 60 years various terms have been used to define the disorder, including hyperkinetic impulse disorder, organic driveness, minimal brain dysfunction, hyperactivity attention deficit disorder, and attention deficit hyperactivity disorder (Barkley, 1990, 1997; Campbell & Werry, 1986; Schachar & Logan, 1990). It will also show that changing conceptions have led to somewhat different definitions and emphases in terms of the primary symptoms of ADHD. In brief, in the 1950's and 60's, emphasis was placed on motor activity (Laufer & Denhoff, 1957). By the 1970's the focus shifted to attention problems (Campbell & Werry, 1986; Douglas, 1972; Douglas, 1983; Douglas & Peters, 1979). More recently, more weight has been placed on poor impulse control (Barkley, 1997; Milich et al., 1994). These changes in its terminology and our understanding of its core feature or features have been reflected in the various editions of DSM, i.e., DSM-III (APA, 1980), DSM-III-R (APA, 1987), and DSM-IV (APA, 1994). Thus the discussion of our understanding of ADHD will be reviewed in terms of four historical phases: the period prior to DSM-III, the period during DSM-III, the period during DSM-III-R, and the period since DSM-IV.

2.2 The period prior to DSM-II

The first description of a syndrome comprising symptoms similar to what is now perceived to be the core problems of ADHD was given by (Still, 1902). He described a group of children with "defects in moral control" who manifested overactivity, inattention, learning difficulties and conduct problems. Still was the first to note that the symptoms of some children were defined as unnatural relative to the behaviour of normal children at a given age, suggesting that age-referenced criteria were important.

In the 1920's and beyond, several studies appeared claiming to demonstrate a link between brain injury and the behaviour pattern described by Still (Clark, 1926; Hohman, 1922; Lord, 1937; Preston, 1945; Strecker & Ebaugh, 1924). Other terms used during this era for ADHD were “organic driveness” (Kahn & Cohen, 1934) and “restlessness syndrome” (Childers, 1935; Levin, 1938). Because many of the children seen in these samples were also mentally retarded or more seriously behaviourally disturbed, several investigators such as Levin (1938) postulated that such children had defects in forebrain structure. As a result hyperactivity was linked to “brain injury”.

The concept of the “brain-injured child” later evolved into the concept of “minimal brain dysfunction”. This was largely due to the work of Strauss and colleagues (Strauss & Kephart, 1955; Strauss & Lehtinen, 1947). They reported on a group of mildly mentally retarded children without demonstrable brain injury who evidenced hyperactive behaviour. They argued that if children with known brain injury showed hyperactive behaviour, then children without obvious evidence of brain injury showing hyperactivity must also suffer from brain injury. They coined the term “minimal brain damage disorder” to refer to this disorder.

Birch (1964), and Herbert (1964), were two of the first critics of the purported links between brain injury and hyperactivity, as they found that there was virtually no evidence to support such a medical concept of hyperactive behaviour. Consequently, these findings led Clements (1966) and other researchers to replace the term “minimal brain damage” with “minimal brain dysfunction” (MBD). Within this conceptualisation of hyperactivity, so-called ‘soft” signs (increased slow wave activity on EEG, fine motor co-ordination problems) and developmental factors associated with prenatal, perinatal and postnatal birth difficulties were inferred to be prognostic indicators of MBD (for review see Wender, 1971,). This view of hyperactivity was soon widely criticised (Campbell & Werry, 1986; Ross & Ross, 1982; Rutter, 1989; Taylor, 1986) because the data identified as markers of MBD were also identified in other psychiatrically disturbed children such as children with autism, schizophrenia or affective disorders. Most critically, the data was not necessarily present in all children with those cognitive and behavioural deficits perceived to be synonymous with hyperactivity. Thus the concept of MBD increasingly became recognised as vague, overinclusive and of little or no diagnostic value (Kirk, 1963; Rutter, 1983).

As dissatisfaction with the term MBD increased, the concept of an "hyperactive child syndrome" gained credence. Due to uncertainties about aetiological factors, especially the role of brain pathology, there was a movement toward focusing on observable behavioural problems. Laufer and Denhoff (1957) were probably the first to provide a systematic description of hyperactivity, suggesting that the main features were increased motor activity, short attention span, poor concentration, performance and behavioural variability, impulsivity, inability to delay gratification, irritability, explosiveness and poor school performance. The concept of "hyperkinetic behaviour syndrome" and "hyperkinetic impulse disorder"(Laufer & Denhoff, 1957) replaced the concept of MBD.

In terms of the new conceptualisation of the disorder, Chess (1960) regarded "overactivity" as its defining feature. In support of this view, other studies comparing problem behaviour children and normal children, found that the symptoms of the disorder were primarily characterised by hyperactivity (Smith, 1962; Werry, Weiss, & Douglas, 1964).

2 . 3 DSM-II: The era of the hyperkinetic child

At this time there was a reorientation from the concept of minimal brain dysfunction to one that recognised the primacy of systematic behavioural observation. This provided the impetus for the major classification systems to regard hyperactivity as the core feature of the disorder. DSM-II (APA, 1968) referred to the hyperactive disorder as "Hyperkinetic Reaction of Childhood", while the World Health Organisation Multi-axial Classification System (WHO, 1978) referred to it as "Hyperkinetic Syndrome". Consistent with research findings existing at this time both of these classification systems emphasised overactivity as the core feature. Poor attention was also listed as a secondary feature. Although DSM-II briefly described the excessive activity level of hyperactive children it provided very few details pertaining to the diagnostic process. For diagnosis to occur a child's behaviour had to match the published description of the disorder. Although the emphasis was now on hyperactivity, the disorder was thought to be a relatively benign condition which often disappeared at the onset of puberty and was manageable with stimulant medication and psychotherapy (Barkley et al., 1990). Despite the obvious shortcomings regarding clear definition and operationalisation of the hyperactivity construct, DSM-II provided a positive trend by narrowing the behavioural parameters thought to define ADHD.

2 . 4 DSM-III: The period of attention deficits

DSM-III (APA, 1980) radically reconceptualised the disorder and for the first time the hyperkinetic behaviours were clustered into discrete categories. Based primarily on the cognitive studies by Douglas and associates (for reviews, see

Douglas, 1972, 1976, 1980; Douglas & Peters, 1979) three separate dimensions were listed in DSM-III; namely inattention, impulsivity and hyperactivity. For inattention there were 4 symptoms, for impulsivity 5 symptoms, and for hyperactivity 4 symptoms.

As distinct from DSM-II that posited hyperactivity as the core feature of the disorder, DSM-III indicated an important shift in focus by emphasising inattention rather than hyperactivity as the primary deficit. It recognised two subtypes, Attention Deficit Disorder without Hyperactivity (ADD), and Attention Deficit Disorder with Hyperactivity (ADDH). Its title was "Attention Deficit Disorder with and without Hyperactivity".

When the criteria for only inattention and impulsivity were met, the diagnosis was "Attention Deficit Disorder without Hyperactivity" (ADD) whereas when the criteria included hyperactivity symptoms the diagnosis was "Attention Deficit Disorder with Hyperactivity" (ADDH). The latter group was considered to be a sub-group of ADD. Although a diagnosis of ADD included both the inattention and impulsivity symptoms, impulsivity was considered to be secondary to inattention.

For diagnosis of ADD there were several key criteria. The first criterion specified a monothetic and categorical structure with at least 3 symptoms from both the inattention and impulsivity dimensions and at least 2 symptoms from the hyperactivity dimension. A second criterion specified an age of onset prior to age 7 years, while a third criterion required symptom duration of at least 6 months. Finally, it was stipulated that the disorder had to be independent of schizophrenia, affective disorder or severe or profound mental retardation. It was also made mandatory for the symptoms to be reported by adults such as teachers and parents, although a greater emphasis was be placed upon teacher reports because of their greater familiarity with age-appropriate norms.

2.4.1 Evaluation of DSM-III diagnostic criteria

DSM-III was a landmark in official nomenclature. The earlier classification systems based, often on erroneous assumptions and a lack of theoretical and empirical evidence about the nature and characteristics of the disorder had given prominence to hyperactivity with attention problems regarded as subsidiary. Although the new diagnostic criteria represented a considerable improvement over past classification systems, they also were not truly empirical, as they appeared to be based on a specific perspective represented in a number of research studies (especially those of Douglas and colleagues), rather than a broad range of objective evidence.

Nevertheless, the new diagnostic criteria were notable, because the emphasis was shifted from hyperactivity as the core deficit, to a recognition that inattention (and to a lesser extent impulsivity) appeared central to an understanding of the disorder. Hence DSM-III reconceptualised the disorder as ADD with or without Hyperactivity. DSM-III was also notable for its creation of much more specific symptom lists, numerical cutoff scores for symptoms, guidelines for age of onset and duration of symptoms, and the exclusion of other childhood psychiatric conditions such as schizophrenia, affective disorders or severe or profound mental retardation.

Despite these advancements, DSM-III was principally criticised because of the lack of evidence to support the new typology, in particular the shift in focus from hyperactivity to inattention as the central component of the disorder. The criteria were further criticised because, although the DSM-III criteria were specific, in that they outlined a list of symptoms, and stipulated the numbers of symptoms within the dimensions of inattention, impulsivity and hyperactivity required to fulfil the two different subtypes of ADD, they were not truly operational in that they did not spell out a diagnostic process to determine the presence of those symptoms (Barkley, 1990). In particular DSM-III lacked a clear empirical basis for the recommended cutoff number of symptoms for ADD and ADDH (Achenbach & Edelbrock, 1983; Spitzer, Davies, & Barkley, 1990)

While by the later 1980's the recognition of Attention Deficit Disorder as a distinct diagnostic entity was regarded by many researchers and clinicians as a quantum leap in the classification of childhood disruptive behavioural disorders, it still remained that during the 1980's there was still considerable debate about the division of Attention Deficit Disorder into two subtypes, ADD (without hyperactivity), and ADDH (with hyperactivity).

A major outcome of the clearer definitions of criteria provided in DSM-III was an abundance of research studies. These research studies raised two important issues. The first issue was whether Attention Deficit Disorder was distinct from other disorders, especially disorders related to aggressive behaviour and conduct problems. The second issue was the distinction between the two subtypes ADD and ADDH, as it was unclear whether there were two distinct disorders or whether there were two forms of a single disorder (Cantwell & Baker, 1984, 1988, 1992; Carlson et al., 1986).

Related to the issue of whether the symptoms of ADDH in DSM-III were distinct from other disorders, Loney and her colleagues (1978, 1982) attempted to differentiate the symptoms of hyperactivity from those of aggression or conduct problems. Using factor analysis, Loney demonstrated that a relatively short list of hyperactivity symptoms could be empirically separated from a similar short list of aggression symptoms. Also, the hyperactivity dimension was related to academic and learning problems, whereas conduct problems were related to aggression, peer relations and family adversity. The findings of Loney and associates were very significant because they were one of the early pioneers attempting to empirically demonstrate different behavioural outcomes for clusters of symptoms for either purely hyperactive or purely aggressive children.

2 . 5 DSM-III-R: The time of undifferentiation between symptoms

During the early and mid 1980's such was the apparent lack of supporting evidence for the subtype approach of DSM-III that it was replaced in DSM-III-R by a system wherein all the symptoms of inattention, impulsivity, and hyperactivity were grouped together as a single diagnostic category. The original decision by the DSM-III-R Childhood Disruptive Disorders planning committee (APA, 1991) was to eliminate the distinction between ADD and ADDH altogether and replace them with a single dimensional diagnostic system termed Attention Deficit Hyperactivity Disorder (ADHD). Part of the rationale for such a substantial change was that a diagnosis of attention deficit without hyperactivity is "hardly ever made" (APA, 1987, p. 411).

However, in the final draft of DSM-III-R, the DSM committee relented with the retention of ADD as a sub-category, but its significance was downgraded as it was relegated to a sub-category termed Undifferentiated Attention Deficit Disorder (UADD). This new sub-category was included to classify disturbances in which the predominant feature was the persistence of developmentally inappropriate and marked inattention (APA, 1987, p. 95). The revised edition of DSM (DSM-III R; APA, 1987) provided a single list of 14 symptoms covering the dimensions of inattention, impulsivity and hyperactivity. As already noted, the disorder was termed Attention Deficit Hyperactivity Disorder (ADHD). Similar to DSM-III, 8 symptoms were required for diagnosis, however unlike DSM-III, the basis for diagnosis was dimensionally undifferentiated. The symptoms were not specified in terms of different dimensions because, on the basis of the field trial, the DSM committee believed that there was no clear evidence as to which symptoms reflected inattention, impulsivity and motor activity (Lahey et al., 1988).

The diagnostic criteria specified that the symptoms must appear before the age of 7 years. The 14 symptoms were listed in order of discriminating power based on the data from a national field trial, and a further condition stipulated that the child does not meet the criteria for Pervasive Development Disorder.

Further new severity criteria specified that the symptoms could be classified as “mild”, “moderate” or “severe”. The new severity criteria stipulated that for “mild” ADHD, diagnosis was to be based on school and social functioning impairment. No cross-situational criteria were stated for “moderate”, however for “severe” ADHD, diagnosis was on the basis of impairment at home, school or with peers.

Finally, DSM-III guidelines had suggested the diagnosis of the disorder generally on the basis of teacher or parent report. However when there were conflicting opinions, teacher report was to be given greater precedence over parent report. DSM-III-R removed this criterion and introduced new severity criteria which, according to severity level, stipulated impairment based on both "school and social functioning" or 'in functioning at home and school and with peers".

2.5.1 Evaluation of DSM-III-R diagnostic criteria

Barkley and his associates were the main supporters of the DSM-III-R diagnostic criteria. Barkley (1990) claimed that DSM-III-R had greater empiricism than DSM-III because it was based on a nation-wide field trial, factor analyses, other research and clinical evidence, and improved situational criteria.

Barkley and colleagues have indicated that, unlike DSM-III where the symptoms of the disorder had been chosen on the basis of committee consensus, the symptoms used to make DSM-III-R diagnosis had been selected primarily on the basis of factor analyses of clinician's assessments of structured child and parent interviews, school records and psychometric tests or laboratory measures (Barkley, 1990; Spitzer et al., 1990). Also both Barkley (1990) and Spitzer et al. (1990) have contended that, unlike DSM-III, the cut-off point for diagnosis in the unidimensional DSM-III-R was based on a field trial thereby giving it some degree of internal validity.

As well, the introduction of severity impairment criteria was regarded as a very important innovation in DSM-III-R that reflected the growing research and clinical findings of the range and variability of the ADHD symptoms. In particular, the degree of pervasiveness of the symptom criteria was a critical recognition of the severity of the disorder (Barkley, 1990).

In contrast to DSM-III, the items in DSM-III-R were no longer clustered within the separate dimensions of inattention, impulsivity and hyperactivity, with each having a separate cut-off score for determining its diagnostic significance.

Barkley (1990, 1998) contended that such a monothetic approach to the symptoms of ADHD was more consistent with the dimensional view taken of other psychiatric disorders in DSM-III-R. Indeed, August and Garfinkel (1993) claimed that the DSM-III polythetic model of ADHD identifed substantially fewer cases when compared to the monothetic schema of DSM-III-R. Barkley (1998) has also suggested that due to the high degree of intercorrelation between the ADHD symptoms, that it would be imprudent to classify the symptoms into subtypes as had been done in DSM-III.

However, despite the support of Barkley and his colleagues, DSM-III-R has received trenchant criticism from many classification experts (Cantwell & Baker, 1988, 1989; Lahey et al., 1988; Lahey & Carlson, 1991; Newcorn et al., 1989; Rutter, 1988). That, when the DSM-III-R field trials were conducted in early 1985 the DSM committee officially stated that "a diagnosis of ADD without hyperactivity is hardly ever made" has been regarded as quite perplexing (Cantwell & Baker, 1984, p. 316). At that time there was evidence from well-designed factor studies (Costello, Edelbrock, Kalas, & Dulcan, 1984; Swanson, Nolan, & Pelham, 1979), based on the DSM-III symptom list attesting to the distinction between the symptoms of children with inattention problems with and without hyperactivity. Carlson's (1986) literature review concluded that the behaviour patterns displayed by the attention deficit groups were so dissimilar that it seemed unlikely that they should be considered as a single disorder.

In addition, the seminal work by Hinshaw (1987) reviewing approximately 30 factor-analytic studies of the disruptive behaviour disorders in the past two decades, had found support for two dimensions of inattention and hyperactivity. Indeed, the findings of many factor analysis studies of DSM-III-R have confirmed that the unidimensional DSM-III-R structure was predicated on inadequate empirical evidence. These studies found that despite substantial differences in the diagnostic criteria between DSM-III and DSM-III-R, that a two-factor solution of inattention and hyperactivity-impulsivity prevailed for both DSM-III and DSM-III-R (Lahey et al., 1988, 1990; Healey, Newcorn, Halperin, & Wolf, 1993; Newcorn et al., 1989).

Werry et al. (1987) contended that the new criteria were "hastily derived" and "largely untested" and were more substantial than was warranted. A fundamental concern was the lack of empirical evidence to justify the unidimensional approach of DSM-III-R (Cantwell & Baker, 1988; Lahey & Carlson, 1991; Rutter, 1989). A major and somewhat telling criticism of DSM-III-R was that the unidimensional approach did not appear to fit with the clinical impressions of practitioners (Shaywitz & Shaywitz, 1988). Lahey and Carlson (1991) contended that DSM-III-R failed to provide diagnostic criteria for UADD, failed to clarify the independence of inattention from hyperactivity or impulsivity, and as a result the DSM-III-R classification system would inadvertently lead to misdiagnosis. Finally, the new severity criteria in DSM-III-R were criticised as the guidelines accompanying the three severity levels appeared somewhat arbitrary if not inconsistent (Goldstein & Goldstein, 1990).

In retrospect, as indicated by the criticisms of the above researchers, DSM-III-R inadvertently created two new sub-categories of hyperactivity, one characterised by overactivity and impulsivity but without inattention, and the other inattention and overactivity without impulsivity.

In essence, the main weaknesses could be summarised as follows: (i) the removal of subtypes was contrary to the available evidence, (ii) the unidimensional structure was predicated on inadequate evidence, (iii) the diagnostic criteria could lead to errors in diagnosis, (iv) the assumptions underlying the categories of ADHD and UADD were flawed, (v) there was a failure to provide diagnostic criteria for UADD, and (vi) the cross-situational impairment criteria were too arbitrary.

2 . 6 Emergence of empirical based operationalisation of diagnostic criteria

Whatever the strengths and limitations of DSM-III or DSM-III-R, and despite the undoubted improvements in diagnostic classification afforded by the former systems, by the late 1980's there was a vigorous debate regarding the appropriateness of the existing item structure and the means to validate the symptoms for ADHD. Several expert clinicians (Quay, 1986; Rutter, 1989; Werry et al., 1987) were at the forefront of a movement toward greater clarity, specificity and operationalisation of diagnostic criteria for ADHD and other psychiatric disorders. In particular issues of comorbidity between ADHD and other disorders such as conduct disorders, anxiety disorders and learning disorders were often unresolved, due to poorly conceived criteria for group membership and subject selection (Cantwell & Baker, 1988; Hinshaw, 1987; Lahey et al., 1988; Loeber & Schmaling, 1985).

Thus the late 1980's saw clinicians and researchers increasingly focusing on whether the defining symptoms and characteristics of ADHD could discriminate ADHD from the defining symptoms and characteristics of other childhood psychiatric disorders. Not surprisingly a bi-product of these more empirical approaches to diagnostic classification was a greater understanding of the co-morbidity of ADHD with other disorders.

In summary, the period of DSM-III and DSM-III-R marked great changes in understanding and expertise in the development of diagnostic classification. By the early 1990's there was a well-established debate concerning the relative merits of the respective diagnostic systems, and in particular there were such grave concerns about the unidimensional structure of DSM-III-R that the DSM Planning Committee was compelled to undertake further revisions to the ADHD diagnostic criteria.

2 . 7 DSM-IV: The return to subtypes

While DSM-IV has retained the same diagnostic label of "ADHD", the diagnostic criteria for DSM-IV ADHD are different from those in DSM-III-R. As opposed to DSM-III and DSM-III-R which both had a list of 14 symptoms, albeit slightly different symptom lists, the DSM-IV ADHD criteria contain a list of 18 symptoms under three separate dimensions: inattention (9 symptoms), hyperactivity (6 symptoms), and impulsivity (3 symptoms). Furthermore DSM-IV recognises three subtypes of ADHD: the "predominantly combined subtype" (at least 6 inattention and 6 hyperactivity-impulsivity symptoms), the "predominantly inattentive subtype" (at least 6 inattention symptoms) and "predominantly hyperactive-impulsive subtype" (at least 6 hyperactive-impulsive symptoms).

Thus although DSM-IV ADHD criteria contain separate dimensions of inattention, hyperactivity, and impulsivity, no distinction is made between hyperactivity and impulsivity symptoms (as in DSM-III) for the purpose of diagnosis. The predominantly combined subtype is comparable to ADDH and ADHD of DSM-III and DSM-III-R respectively, while the predominantly inattentive subtype is comparable to ADD in DSM III, and to some degree UADD in DSM-III-R. The predominantly hyperactive-impulsive subtype is new. In addition and unlike previous DSM editions, concern about false-positive diagnosis led to the inclusion of a totally new DSM criterion that specifies that the ADHD symptoms must be present in two or more settings (e.g., at school and at home). This inclusion was designed to make DSM-IV criteria more specific and give it greater clinical impact (e.g., pervasiveness over settings). To some degree this change was an attempt to refine the severity criteria for ADHD in DSM-III-R, with the former highly debatable and somewhat arbitrary and subjective "mild", "moderate" and "severe" severity criteria being more specifically targeted to school and home settings in DSM-IV.

2.7.1 Evaluation of DSM-IV diagnostic criteria

In evaluating the comparative changes from DSM-III-R to DSM-IV it is clear that DSM-IV represented a substantial step forward in the development of the classification process. Its main strengths being that, firstly, it recognised the separation of inattention from hyperactivity-impulsivity, and in so doing this it also recognised the central role of inattention (as formerly espoused by DSM-III). Secondly, it was based on improved ways to validate the ADHD symptoms, including a better methodology and analyses of the nation-wide field trials. Other strengths were more reliable case identification, improved identification of ADHD symptoms in girls, improved situational impairment criterion, and symptom cutoffs being based on more rigorous field trials than those in DSM-III-R.

Specifically referring to the developmental phase underpinning the changes in DSM-IV, it is clear that DSM-IV came about because of the recognition by the DSM-IV Planning Committee of the continuing widespread concerns about the comparative merits of the diagnostic structures in DSM-III and DSM-III-R. In particular, the existing literature suggested that neither the DSM-III three-dimensional approach, nor DSM-III-R unitary diagnostic model were appropriate representations of the ADHD symptoms. Indeed the existing data suggested two separate dimensions for the organisation of the ADHD construct, one composed of inattention symptoms, and the other composed of excessive motor activity and impulsivity. For example, exploratory factor analysis studies using the ADHD symptoms within both DSM-III and DSM-III-R respectively, had supported a two-factor structure for both clinic-referred and normative samples (Bauermeister, Alegria, Bird, Rubio-Stipec, & Canino, 1992; DuPaul, 1991; Lahey et al., 1988; Newcorn et al., 1989; Pelham, Gnagy, et al., 1992).

As well, McBurnett (1994), one of the DSM-IV Disruptive Behaviour Disorders Committee members, reviewed eight factor analyses that included both clinic and normative samples, and concluded that all but one supported inattention and hyperactivity-impulsivity as the separate core dimensions of ADHD. Significantly, Bauermeister (1992) also had reported that the two-factor split remained even when the analyses were performed for two age groups (i.e., 4-5 and 6-13 years). These studies are further reviewed in chapter 3.

Subsequently, supporting the findings in the existing literature, the field trials also confirmed the independence of the inattention and hyperactivity-impulsivity groups of symptoms on the basis of external correlates. The hyperactivity-impulsivity symptoms were associated with global impairment, while the inattention symptoms were associated with academic impairment (Frick et al., 1994; Lahey et al., 1994; McBurnett, 1994).

Prior to the new DSM-IV structure being tested by research, the DSM-IV Disruptive Behaviour Disorders Committee published its findings on the field trials data (Lahey et al., 1994). These findings suggested several strengths of the DSM-IV criteria. First, the new criteria appeared to reduce the heterogeneity of DSM-III-R in terms of symptoms, impairment, and demographics by distinguishing among children with primary dysfunction in inattention, hyperactivity-impulsivity, or both. Second, based on improved method and analysis underpinning the diagnostic criteria, DSM-IV improved case identification and had greater cross-informant reliability than DSM-III-R due to the field trials being based on teacher and parent report as well as clinical judgment. Third, by providing specific diagnostic criterion for the "predominantly inattentive" subtype, the DSM criteria operationalised the category of UADD for the first time since its approximation as the category of ADD in DSM-III.

The DSM committee also referred to the substantial improvement in DSM-IV over DSM-III-R in identifying girls with ADHD. The inclusion of the "predominantly inattentive subtype" made it more likely that DSM-IV criteria would be able to diagnose many children, especially girls, who previously may have been missed under DSM-III-R. Given that the field trials had identified girls as more likely to represent the predominantly inattentive subtype than the hyperactive-impulsive subtype, the inclusion of a separate category for mainly inattentive children represented an important modification to the DSM-III-R in terms of gender differentiation and diagnosis. Moreover, as the DSM-IV planning process had entailed comparison with the two previous DSM's, such a process was a recognition of the critical role played by attention deficits which had formerly been emphasised by DSM-III, but unfortunately downgraded by DSM-III-R.

DSM-IV has also proximally returned to the subtyping of Attention Deficit Disorder with and without Hyperactivity (ADDH and ADD) as first proposed by DSM-III, although in DSM-IV, ADD has become "ADHD predominantly inattentive" subtype and the symptoms of impulsiveness are no longer necessary. Barkley (1998a) believes that, as opposed to DSM-III-R where the diagnostic structure made it entirely possible for inattention symptoms to be devalued, such subtyping permits clinicians the opportunity to diagnose clinic-referred children who have significant attentional dysfunction but no significant disinhibition. He further contends that the new subtyping will better facilitate the sort of research needed to establish whether this subtype is a true subtype of ADHD, or whether, as proposed by Milich, Balentine, and Lynam (2001) the predominantly inattentive subtype is an entirely qualitatively different disorder from that seen in the predominantly combined subtype.

Finally, the specification for establishing the degree of situational pervasiveness of the symptoms in DSM-IV appears to be superior to that in DSM-III-R. The DSM-III-R guidelines were arbitrary, if not inconsistent, whereas the DSM-IV guidelines appear much more consistent and less arbitrary. It is stipulated that symptoms must be maladaptive according to developmental level. As previously noted, there were difficulties associated with the three severity levels in DSM-III-R. In DSM-IV, these difficulties have been minimised, leading to a more balanced report regime. Informants such as teachers and parents only need to note some symptom impairment across home and school settings, however a new criteria has been introduced that highlights the critical importance of diagnosis being based on clinically significant impairment using multimodal assessment. Such a process may elevate the importance of appropriate clinical diagnostic procedures as well as not diminish the roles played by both teachers and parents.

By contrast to the undoubted strengths of the new diagnostic system, research evidence and clinical judgment has identified several concerns regarding the diagnostic criteria, with the most notable being the lack of empirical data to support the validity of the new predominantly hyperactivity-impulsivity subtype. Other concerns identified include shortcomings in age of onset criterion; appropriateness of diagnostic thresholds for different age groups and developmental levels; need for adjustment of diagnostic criteria to reflect gender differences; suitability of 6 months duration criterion; ambiguity of symptom descriptors and pervasiveness criterion; reliability of cross-situational diagnostic criterion.

The most critical shortcoming identified in research studies pertains to the validity of the new hyperactivity-impulsivity subtype. While most studies point to clear distinctions between the inattentive and combined subtypes, concerns have been raised about the independence of the hyperactive-impulsive subtype. Lahey et al. (1997) has commented that the skewed age distribution of children in the hyperactive-impulsive group in the DSM-IV field trials raises concern about the validity of the new hyperactivity-impulsivity subtype. Several leading researchers (Barkley, 1998a; Hart, Lahey, Loeber, Applegate, & Frick, 1995; Lahey et al., 1998; McBurnett et al., 1999) have indicated that the earlier age manifestation of hyperactivity-impulsivity behaviours may be part of a chronological ADHD developmental continuum rather than the representation of a new ADHD subtype. Thus the symptoms of hyperactive-impulsive behaviour in the very young ADHD child may interact with the attention problems of school age and lead to the development of the combined ADHD subtype.

Further corroboration for this view is provided by the DSM-IV field trials (Lahey et al., 1994). In the field trials only 24% of the children who met criteria for the hyperactive-impulsive subtype were older than 6 years, compared with more than 70 % of the children who met criteria for the combined and inattentive subtypes. Thus it may be as Lahey et al. (1997) has argued, that older children are unlikely to meet criteria for the hyperactive-impulsive subtype because they meet criteria for the combined subtype instead.

Both DuPaul et al. (1998) and McBurnett et al. (1999) have also found that the hyperactive-impulsive child is referred at an earlier age than the other subtypes and a more recent study has found that the prevalence of hyperactivity-impulsivity symptoms drop precipitously after the preschool years, whereas the inattention symptoms increase dramatically (Nolan et al., 2001). Developers of the previous version of DSM had been reluctant to affirm the distinction between ADD and ADDH because they judged there were insufficient data to support the differentiation. Given this, both the above research teams contend that it is surprising that DSM-IV presents a new subtype of ADHD with little empirical data to support it.

Other investigations corroborating an ADHD developmental continuum (Lalonde, Turgay, & Hudson, 1998; Faraone et al., 1998; Paternite et al., 1996) have indicated that hyperactivity-impulsivity may occur earlier as a result of neurological deficit, whereas both the combined and inattentive subtypes (with inattention being symptomatic of both) are more likely to occur during the school years. Other studies (Burns, Walsh, Owens, & Snell, 1997; Burns, Walsh, Patterson, et al., 1997) have cast further doubt on the independence of the hyperactivity-impulsivity subtype, as many of the latter's symptoms cannot be differentiated from the ODD and CD symptoms. These authors have suggested that future studies should examine the internal validity of the hyperactivity-impulsivity symptoms more closely, especially their association with the ODD and CD items.

Conversely, twin studies of both boys and girls (Hudziak et al., 1998; Sherman et al., 1997), have supported the validity of an hyperactive-impulsive subtype. Yet, despite their findings, Hudziak et al. (1998) have still issued a cautionary note regarding the DSM-IV ADHD subtypes. Overall they have indicated that they favour a developmental process for ADHD and have qualified their findings by stating that, as a diagnostic process, subtyping remains highly subjective as it is subject to arbitrary decisions about symptom cut-off points.

Another problem is related to the age of onset criterion. Somewhat surprisingly to many experts, the age of onset criterion (some symptoms before age 7 years), first appearing in DSM-III and retained in DSM-III-R, was not based on empirical evidence. Moreover, there has been further criticism of the fact that DSM-IV also retained the 7 years of age criterion prior to analysis of this aspect of the field trial data (Applegate et al., 1997; Barkley, 1997)

Barkley (1990), Barkley and Biederman (1997), and Applegate et al. (1997) have pointed out substantial shortcomings in age of onset criterion. Applegate et al. (1997) examined the validity of the DSM-IV age of onset criterion with a clinic-referred sample of children aged 4 to 17 years. Although all children met the diagnosis of ADHD, all subjects within the combined or hyperactive-impulsive subtype met the onset of at least one symptom for age 7 years, whereas 50% of those with the inattentive subtype did not. Eighteen percent of those having the combined subtype, 2% of those having the hyperactive-impulsive subtype, and 43% of those having the inattentive subtype had their onset of impairment after age 7 years. Further, requiring impairment prior to 7 years of age appeared to reduce the accuracy of identification of currently impaired cases of ADHD and reduced agreement with clinician's judgment.

Barkley and Biederman (1997) have argued that the age of onset criterion be substantially broadened to include onset of symptoms at any time during childhood. They claimed such a process would be in keeping with the conceptualisation of this disorder as having a childhood onset, while not restricting it with the wholly indefensible and highly specific onset of 7 years of age. They further contended that this would be more suitable for use with adults who would have less difficulty recalling onset symptoms in later childhood, versus recall prior to age 7 years.

Related to this issue is the failure of DSM-IV to stipulate a lower-age boundary for diagnosis. This is critical because pre-school research has shown that hyperactive-impulsive behaviour is indistinguishable from aggressive or defiant behaviours until about 3 years of age (Achenbach & Edelbrock, 1987; Campbell, 1990). Such findings imply that the ADHD symptoms may be difficult to distinguish from other early behavioural disorders (especially ODD) until at least 3 years of age.

Some concern has been expressed regarding symptom cutoff scores. The final structure for the same number of symptom cutoff scores for inattention and hyperactivity-impulsivity, seems to have been based purely on the skewed data provided by field trial data, despite research evidence of the stability of the inattention symptoms with increasing age, and decline in hyperactivity with increased age, (Barkley, 1990; Pelham, Evans, et al., 1992). Moreover that the DSM-IV planning committee originally set a lower cutoff score of five (5) for the hyperactivity-impulsivity symptoms (Lahey et al., 1994) makes it quite perplexing that the cutoff score for the hyperactivity-impulsivity symptoms was revised to six when DSM-IV went to press.

A further problem with DSM-IV is that the diagnostic thresholds may not necessarily be appropriate to different age groups outside those used in the field trials (age 4-16 mainly). Indeed of the seven different age-groups analysed in the field trials, the two youngest age-groups (4 or 5, 6 or 7) and the two highest age-groups (14 or 15, 16 or 17) represented 43% and 13 % respectively of the total sample. Given that research has documented that ADHD symptoms decline significantly with age, particularly the hyperactive-impulsive symptoms (Hart et al., 1995; McBurnett et al., 1999) applying the same threshold to all age-groups could result in inappropriate diagnosis for those children at the extremes of the age distribution. In particular, an inappropriate diagnosis might be given to pre-school and younger children (false-positive) and young adults (false-negative). With regard to the latter group, one study (Murphy & Barkley, 1996) found that, applying the DSM-IV threshold criteria, resulted in many adults (aged 17-29) with definite ADHD symptoms failing to receive an ADHD diagnosis.

DSM-IV, similar to its predecessors, has also not attempted to grapple with whether the diagnostic criteria needs to be adjusted for gender differences. Given the research (Achenbach & Edelbrock, 1983; DuPaul, 1991; Goyette, Conners, & Ulrich, 1978), indicating that male children demonstrate more ADHD symptoms and manifest these symptoms at higher severity levels than female children, together with the findings that there are different external correlates for different ADHD subtypes based on gender (Gaub & Carlson, 1997b), the non-differential approach to diagnosis in DSM-IV seems inappropriate. Moreover, that the data from the field trials was heavily skewed (males 300, females 80) adds further support to the need for gender based diagnostic thresholds.

The stipulation of a 6 months persistence of symptoms criterion also is problematical. It appears that DSM-IV adopted this criterion to maintain consistency with past DSM's, yet there is little or no research to support it. As previously suggested in this overview, behaviours synonymous with ADHD symptomatology may vary considerably, subject to age and developmental factors. In particular, the behavioural variability in pre-school children may be substantially different from even midddle-age primary children. Related to this issue is the fact that no guidelines have been given as to what constitutes "developmentally inappropriate" behaviour, or how to assess it.

Although DSM-IV appears to have improved the diagnostic structure by removing the arbitrary three-tiered severity criteria and replacing it with specifically defined situational impairment criteria, the symptom descriptions are themselves ambiguous and do not provide clear indications of abnormal symptomatology. As part of the diagnostic criteria, DSM-IV stipulates that the symptoms must occur "often", however unfortunately DSM-IV does not operationalise "often".

Finally, the requirement, that the symptoms be demonstrated in at least two of three situations to establish pervasiveness criterion, is problematic. This requirement builds on the earlier, and less well-specified and inconsistent situational impairment criteria provided in DSM-III and DSM-III-R. However, while as previously noted, the situational impairment criteria appear more specific and easier to interpret in DSM-IV, the issue of agreement between teachers and parents potentially remains a major problem. Research has shown that the degree of correlation between teachers and parent reports is modest, often ranging between .30 to .50, depending on the behaviour dimensions being rated (Achenbach, McConaughy, & Howell, 1987). Clearly differences between teacher and parent ratings represent different perceptions based on different perspectives and different contexts, and it is extremely difficult to determine the relative merits of each rater. Thus the insistence on diagnostic agreement may lead to many children not receiving a diagnosis when it is warranted.

2 . 8 Evaluation of the DSM diagnostic approach

The preceding discussion has endeavoured to trace key points in the evolution of the diagnostic process for ADHD, ranging between the earliest days when ADHD could be regarded more as a relatively unproven medical illness or disorder, to the modern era, commencing with DSM-III, when the symptoms were first empirically tested and classified in an organised manner.

The overview, provided in this chapter has demonstrated that there have been different conceptualisations of ADHD in the past three editions of DSM. First, DSM-III radically reconceptualised the DSM-II category of "Hyperkinetic Reaction of Childhood" to "Attention Deficit Disorder with and without Hyperactivity". Within this conceptualisation, inattention was central to an understanding of the disorder, and the disorder was based on the three dimensions of inattention, hyperactivity and impulsivity. Second, its successor DSM-III-R rejected the tripartite structure of ADHD, and proposed ADHD to be a unidimensional construct mainly on the basis of the high degree of correlation between the inattention and hyperactivity-impulsivity dimensions reported in the research studies. Third, DSM-III-R was subsequently modified because empirical studies based on both DSM-III and DSM-III-R found that the two dimensions of inattention and hyperactivity-impulsivity consistently emerged and these results provided the impetus for the development of the dual factorial structure in DSM-IV.

In reviewing the comparative merits of the diagnostic criteria for the ADHD symptoms in DSM-III, DSM-III-R and DSM-IV, it is clear that changes in item numbers, items selected, and item classification between the different diagnostic systems makes it difficult to make meaningful comparisons between the respective symptoms and their contribution to the underlying structure of ADHD.

During the early 1980's many studies suffered from unintentional methodological flaws wherein many designs did not clearly differentiate the ADHD symptoms from other disorders. In particular many studies were unable to clearly differentiate the hyperactivity-impulsivity symptoms from those symptoms pertaining to the more "acting out" disorders such as ODD and CD. With improved methodology during the later 1980's, many researchers using mainly exploratory factor analysis techniques demonstrated the bidimensional structure of ADHD. Considerable controversy surrounded the DSM-III-R years, particularly the decision to downgrade the importance of the inattention symptoms. As well the decision to provide a list of undifferentiated symptoms, according to many experts, led to a period of diagnostic uncertainty and increased the risk of misdiagnosis.

With the benefit of hindsight, more recent studies have now clearly demonstrated that the DSM-III-R unitary diagnostic model was an ill-founded, unfortunate and retrograde step. However the DSM-III-R system was an important turning point in the diagnostic process, as for the first time the symptoms associated with a childhood psychopathology such as ADHD were formally evaluated with diagnostic protocols derived from empirically-based field trials utilising both parent and teacher information based on clinical judgement. During the DSM-III-R years the critical step was also taken to introduce the pervasiveness and situational criteria for the diagnosis of ADHD.

The advent of DSM-IV marked a proximal return to the bidimensional structure of ADHD first proposed in DSM-III in 1980. DSM-IV, based on empirically-driven nation-wide clinical field trials, supported the inattention and bidimensional hyperactivity-impulsivity structure of ADHD and it also proposed a new sub-structure of the ADHD symptoms based on three subtypes; first, inattention (IA subtype), second, a combined inattention and hyperactivity-impulsivity subtype (C subtype), and third, an entirely new subtype, an hyperactivity-impulsivity subtype (H/I subtype).

With its creation of the predominantly combined subtype DSM-IV recognised the relatively equal contribution made by both the inattention and hyperactivity-impulsivity dimensions to the construct of ADHD. By providing specific diagnostic criteria for the predominantly inattentive subtype DSM-IV operationalised the category of undifferentiated attention deficit disorder for the first time since the DSM-III category, Attention Deficit Disorder without hyperactivity (ADD).

Moreover the creation of separate subtypes for each dimension of inattention and hyperactivity-impulsivity was further recognition of the growing body of research evidence supporting distinctions between the inattention and hyperactivity dimensions. Evidence from longitudinal research has suggested that pure subtypes of each dimension may follow different developmental courses, with inattention relatively constant but hyperactivity-impulsivity declining substantially with age (Lahey et al., 1997). In addition, the same study provided evidence showing that the two dimensions differed in terms of association with comorbid disorders with hyperactivity-impulsivity more strongly correlated with oppositional and antisocial behaviours (Lahey et al., 1997).

Given that most younger children in common demonstrate greater hyperactivity, it has been suggested that the new hyperactivity-impulsivity subtype may not necessarily be a valid diagnostic entity. It may be precursive of the combined inattention and hyperactivity-impulsivity subtype (Applegate et al., 1997; Barkley & Biederman, 1997), or it may occur more earlier as a result of neurological deficit (Lalonde et al., 1998). Faraone et al. (1998) have suggested that future longitudinal work should consider the possibility that the DSM-IV subtypes represent different developmental phases of ADHD but these differences are not simply due to age differences.

DSM-IV, in further extending the pervasiveness and situational criteria first introduced by DSM-III-R, has also clearly recognised the critical role of both parents and teachers in the diagnostic process. Power et al. (1998) has further suggested that the diagnostic process will be even more enhanced if future studies were to incorporate both teacher and parent ratings in conjunction with other methods such as diagnostic clinical interviews and direct observation procedures.

2 . 9 Conclusions

In summary, this review has shown that the inception of DSM-III marked the genesis of a more phenomenological and empirical approach to the classification of mental disorders. With respect to ADHD, between the DSM-III years and the current DSM-IV system, the disorder has undergone considerable reconceptualisation, including changes in classification and symptoms.

There has been considerable improvement in the structural organisation of the ADHD symptoms. In particular, in DSM-IV, the structural organisation of the ADHD symptoms has been empirically validated with mainly exploratory (EFA) and confirmatory (CFA) factor analysis. However, as will be argued in detail in chapter 3, recent advances have highlighted the need to examine the structural validity of the ADHD structure using confirmatory factor analysis (CFA) involving multitrait-multisource (MTMS) designs. It is notable that such studies have not been conducted with children with the ADHD diagnosis. Thus one aim of the current study will be to use a CFA MTMS design to examine the convergent and discriminant validity of the DSM-IV structural organisation of the ADHD symptoms with a group of ADHD children.

In relation to external validity, as will be shown in chapter 5, there have only been a limited number of studies that have examined the three different DSM-IV ADHD subtypes. Also, across these studies the three ADHD groups have been compared for only a limited number of external correlates. Given this, the second aim of the study will be to examine differences among the DSM-IV subtypes across a range of variables, including several not examined in previous studies. Overall, therefore the aim of this study is to use CFA MTMS procedures to examine the internal validity of the DSM-IV ADHD symptoms, and as well examine the external validity of the different DSM-IV ADHD subtypes by comparing differences among the subtypes across a range of measures.

The remaining chapters in this thesis are organised as follows. Chapter 3 will examine studies that were aimed at establishing the internal validity of ADHD with the use of EFA and CFA studies. Chapter 4 will present an empirical report aimed at establishing the internal validity of the DSM-IV ADHD symptoms. More specifically, this chapter will provide the results of both EFA and CFA teacher and parent ratings of the ADHD symptoms. In addition, the structural validity of the ADHD symptoms and dimensions (i.e., inattention and hyperactivity-impulsivity) will be examined with CFA MTMS analysis. Chapter 5 will examine studies that were aimed at establishing the external validity of the different subtypes of the disorder as they have appeared in DSM-III and DSM-IV respectively. Chapter 6 will present an empirical report aimed at further establishing the external validity of ADHD based on the subtypes in DSM-IV. More specifically, this chapter will provide the results of teacher and mother ratings of a broad range of measures that have examined differences among the subtypes. These measures will include ODD symptoms, anxiety, IQ and academic functioning, social cognition, aggression style, parenting style, and maternal mental health status. Chapter 7 will present an overall discussion and general conclusions concerning the overall construct validity of DSM-IV ADHD. Both the internal and external validity of DSM-IV ADHD will be discussed, including implications for the conceptualisation, assessment, and treatment of ADHD based on the separate findings of Studies 1, and 2.

CHAPTER 3

INTERNAL STRUCTURE OF THE ADHD SYMPTOMS

3 . 1 Introduction

Chapter 2 has provided an overview of the evolution of the diagnostic system for ADHD in the different DSM editions. As indicated in Chapter 2, a central part of this evolutionary process has been the development of a rigorous and empirical approach to the classification of childhood psychiatric disorders such as ADHD. Initially this chapter will briefly elucidate the process necessary to establish the internal validity of the disorder. Subsequently the main part of this chapter will focus upon the internal structure of the disorder by critically reviewing past classification studies that have examined the internal validity of ADHD.

3 . 2 Establishing the internal validity of ADHD

Loevinger (1957) refers to the process of establishing internal validity as the first stage of construct validity. This stage includes two elements, *substantive* and *structural* validity. Substantive validity refers to the extent to which the items on a measure accurately reflect the psychological atttribute of interest. In the context of ADHD, this refers to the extent to which the symptoms listed in DSM-IV for inattention, hyperactivity and impulsivity, are indeed valid for measuring these constructs. Generally, studies in this respect are those that have examined the relationship of the relevant ADHD symptoms with measures of inattention, hyperactivity and impulsivity, obtained by other means such as objective laboratory based measures, or direct observation.

The second element in clinical validation involves structural validity. Structural validity refers to the extent to which the internal structure of a measure parallels the internal structure of the intended construct. One major approach to identifying and organising symptoms for ADHD has been factor analysis, as either exploratory (EFA) or confirmatory (CFA) techniques. This study proposes to use factor analysis to examine the structural validity of the DSM-IV ADHD symptoms.

From an historical perspective, an overwhelming percentage of early studies were based on factor analysis of ratings scales comprising many behaviours that are now considered to be present in ADHD children. Although the focus of many of these early studies was on the differentiation between hyperactive behaviour and aggression/conduct problems, the preliminary evidence provided by such studies did indicate differences between the dimensions of inattention and hyperactivity.

These studies also showed that the inattention and hyperactivity dimensions were highly correlated (Costello, Edelbrock, Kalas, & Dulcan, 1984; Swanson, Nolan, & Pelham, 1981). However, given the focus of this thesis on the diagnostic symptoms of ADHD, these studies are not reviewed here. Instead this chapter will provide a comprehensive review of the research evidence pertaining to both EFA and CFA studies of DSM-III, DSM-III-R, and DSM-IV symptoms for ADHD. The review of studies for EFA and CFA procedures will be discussed in separate sections, and EFA will be discussed first. Within the context of the usage of the different EFA and CFA statistical methods, it should be noted that, while prior to the late 1980's most studies used only exploratory techniques, since that time there has been a substantial shift toward using more confirmatory techniques based on postulated models of the ADHD symptom structure. This has occurred because more recent research (Waldman, Lilienfeld, & Lahey, 1995) has highlighted the limitations of EFA techniques for establishing the validity of constructs.

Studies based on normative samples and clinical samples will also be examined separately. Table 1 has provided a summary of published studies that have used EFA procedures, and Table 2, the CFA statistical procedures. These tables include (a) studies that have examined the factor structure of the ADHD symptoms, and (b) studies that have examined the factor structure of the ADHD symptoms conjointly with the ODD or CD symptoms. For the purposes of clarity when referring to symptom items, the following abbreviations will be used; inattention (IA), hyperactivity (HYP), impulsivity (IMP), and hyperactivity and impulsivity combined (H/I). As well, for increasing the clarity of past studies, the studies will be reviewed in terms of the symptoms comparing the different editions of the DSM. Wherever possible, details are provided of sample size, sample type, gender numbers, country of origin of the study, together with extraction method, the factors yielded and correlations between the different factors.

The final part of this chapter will discuss the limitations of past EFA and CFA studies in terms of our understanding of the construct validity of the ADHD symptoms, and their implications for future research. Finally, while it is acknowledged that this review may not encompass all published studies, it is suggested that every attempt has been made to represent the available research evidence based on an extremely comprehensive literature search using computer data bases.

3 . 3 Exploratory factor analysis

As already noted, one approach used to establish the construct validity of the ADHD symptoms is exploratory factor analysis. Exploratory factor analysis (EFA) is essentially detective work that acts as a preliminary exploration of indicators of a purported construct and then suggests different possible factor structures for these indicators. EFA makes minimal assumptions about the organisation of the data and utilises mathematical criteria to explore the potential structure of the data. EFA procedures are exploratory, in that they extract the linear combination that accounts for the most available variance among a set of variables. EFA assumes that the unique errors in the observed indicators are independent (i.e., uncorrelated with each other) and EFA extracts factors from the data so as to maximise the common variance or total variance explained. This study will review those studies that have used EFA procedures to examine the factor structure of the core symptoms of ADHD based on the dimensions of inattention, hyperactivity, and impulsivity. A summary of the results from EFA studies is included in Table 1.

3 . 3 . 1 EFA normative sample studies of ADHD symptoms only based on DSM-III diagnostic criteria

Table 1 shows that in all, two normative studies (Healey et al., 1993; Lahey et al., 1988), based on teacher ratings have examined the factor structure of DSM-III ADD symptoms. The study by Lahey and colleagues of kindergarten to grade 5 children demonstrated a two-factor solution. All IA items loaded on factor 1 and all H/I items loaded on factor 2. The 6 IMP items were almost equally divided between factors 1 and 2. The later study by Healey et al. of children in grades 1-6, found that all HYP items loaded on factor 1, and all IA items loaded on factor 2. The IMP items were also divided between the hyperactivity and inattention factors.

3.3.2 EFA normative sample studies of ADHD symptoms only based on DSM-III-R diagnostic criteria

As shown in Table 1, all studies with DSM-III symptom lists have included both boys and girls and have used teacher ratings. Two of these studies have also reported results based on parent ratings (DuPaul, 1991; Bauermeister et al., 1995). From a cross-cultural perspective, studies have examined samples of children from the United States (DuPaul, 1991; Healey et al., 1993), Puerto Rico (Bauermeister et al., 1995), Germany (Baumgaertel et al., 1995), and Brazil (Brito, Pinto, & Lins, 1995).

With respect to the United States studies, Table 1, shows that one study (DuPaul, 1991) evaluated the factor structure of the DSM-III-R symptoms using parent, and teacher ratings. Separate principal component analysis resulted in nearly identical two factor solutions for both teachers and parents. For both sets of ratings, the IA items comprised the first factor and accounted for more than 57% of the variance. The second factor comprised items tapping mainly impulsivity and to a lesser degree motor activity. The teacher ratings showed that two HYP items ("fidgets", "difficulty remaining seated") and one IA item ("easily distracted") had significant loadings on both factors. Parent ratings showed a similar pattern of results, with one additional IA item ("difficulty listening") and two IMP items ("difficulty awaiting turn", "does dangerous things") loading on both factors. Healey et al. (1993) using teacher ratings found a two-factor solution, with IA items in one factor and the H/I items in the other factor. Two IA items ("loses things", "easily distracted"), two HYP items ("difficulty playing quietly", "talks excessively"), and one IMP item ("does dangerous things") loaded on both factors.

Studies conducted in other countries have also generally confirmed the inattention and hyperactivity-impulsivity dimensions as the factor structure for the DSM-III-R symptom list. The Puerto Rican study (Bauermeister et al., 1995), reporting on both teacher and parent ratings, found an inattention and hyperactivity-impulsivity factor solution. For teachers, three items had cross-loadings. Two IA items ("fidgets", "difficulty following instructions") and one IMP item ("difficulty awaiting turn") had significant loadings on both factors. Parent ratings indicated that one IA symptom ("fidgets") and one HYP symptom ("talks excessively") cross-loaded. The Brazilian study (Brito et al., 1995) using teacher ratings found support for an inattention and hyperactivity-impulsivity factor structure. One IA item ("shifts activities") had a significant loading on both factors.

3 . 3 . 3 EFA normative sample studies of ADHD symptoms only based on DSM-IV diagnostic criteria

As shown in Table 1, all studies that have examined DSM-IV ADHD symptoms have included both boys and girls and have obtained scores based on teacher and/or parent ratings. Three studies reported on teacher ratings only (DuPaul et al., 1997; Rohde et al., 2001; Yang, Schaller, & Parker, 2000), two studies reported on parent ratings only (DuPaul et al., 1998; Hudziak et al., 1998), and three studies reported on both teacher and parent ratings (Holland, Gimpel, & Merrell, 1998; Magnusson, Smari, Gretarsdottir, & Brandardottir, 1999; Weiler, Bellinger, Marmor, Rancier, & Waber, 1999). While most studies have been conducted in the United States, studies have also been conducted in Taiwan (Yang et al., 2000), Brazil (Rohde et al., 2001), and Iceland (Magnusson et al., 1999).

Table 1 reveals that all studies reporting on teacher ratings confirmed the two-factor structure of inattention and hyperactivity-impulsivity as proposed in DSM-IV. While there was support for the inattention and hyperactivity-impulsivity factor structure of the DSM-IV symptoms the items comprising the two factors have not been consistent across the studies.

The majority of studies reported evidence of symptom overlap between the two factors. For example, in the study by DuPaul et al. (1997) two IA symptoms ("can't sustain effort", "difficulty organising tasks") had cross-loadings on both factors. The teacher ratings in the Taiwanese study by Yang et al. (2000), indicated that, for boys, four HYP symptoms ("fidgets", "leaves seat", "runs/climbs excessively", "difficulty playing quietly"), and two IA symptoms ("difficulty sustaining attention", "doesn't seem to listen") cross-loaded, and for girls, two HYP symptoms ("fidgets", "talks excessively"), one IA symptom ("doesn't seem to listen"), and one IMP symptom ("difficulty awaiting turn") cross-loaded. The results of the study by Magnusson et al. (1999) show one IA symptom ("often easily distracted") also loading in the H/I factor.

As with the studies reporting on teacher ratings, all studies using parent data confirmed the DSM-IV factor structure by separating the inattention and hyperactivity-impulsivity dimensions. However the extent of cross loading on both factors has not been as evident as with teacher ratings. DuPaul et al. (1998)

using a sample of 4666, aged 4-20 years, showed that two IMP items ("difficulty awaiting turn", "does dangerous activities"), and one IA item ("doesn't listen") had significant loadings on each factor. All other studies (Holland et al., 1998; Hudziak et al., 1998) did not report any symptom loadings for their factor analyses. Taken together, the data showed that each study confirmed the inattention and hyperactivity-impulsivity factor structure for the ADHD symptoms.

3 . 3 . 4 EFA normative sample studies of ADHD-ODD/CD symptoms based on the different DSM editions

First, there are no known studies based on DSM-III. As shown in Table 1 there are only two published studies based on DSM-III-R, and both are by the same team study (Pelham, Gnagy, et al., 1992; Pelham, Evans, et al., 1992). Both studies used teacher ratings and sampled boys only.

One study (Pelham, Gnagy, et al., 1992), using a sample of normal school boys revealed three factors. The factor structure provided support for the DSM-IV organisation of the ADHD symptoms with the dimensions of inattention and hyperactivity-impulsivity representing two of the three factors, the remaining factor being a mainly ODD factor. There was evidence of some symptom overlap between the inattention and hyperactivity-impulsivity factors with two HYP items ("fidgets", "difficulty remaining seated") and one IA item ("easily distracted") loading on each of the inattention and hyperactivity-impulsivity factors.

Table 1

Summary of EFA Studies Based on DSM-III, DSM-III-R, and DSM-IV Diagnostic Criteria

Study	Country & sample type	Diagnostic criteria & rater*	Symptoms	Extraction method*	Factors yielded	Correlations
Bauermeister (1992)	Puerto Rico; C: Age 4-13, M=4.49, (B 720, G, 625)	DSM-III-R (T)	ADHD-ODD	PCA-varimax	1: IA 2: H/I 3 ODD + 4 CD items	
Bauermeister et al. (1995)	Puerto Rico; NC: Age 9-17, (B 125, G 123)	DSM-III-R (T & P)	ADHD	PCA-varimax	1: IA 2: H/I	
Baumgaertel et al. (1995)	Germany; NC: Age 5-12, (B, 1077)	DSM-III-R (T)	ADHD	PCA-varimax	1: IA 2: H/I	
Brito et al. (1995)	Brazil; NC: M= 11.2, (B 782, G 1300)	DSM-III-R (T)	ADHD	PCA-varimax	1: H/I 2: IA	
DuPaul (1991)	USA; NC: Age Gr 1-6, (B 279, G 285)	DSM-III-R (T)	ADHD	PCA-varimax	1: IA 2: H/I	
DuPaul et al. (1997)	USA; NC: Age 4-19, (B 2054, G 1934)		ADHD	PAF-oblique	1: IA 2: H/I	r = -.70
DuPaul et al. (1998)	USA; NC: Age 4-20, (B 2134, G 2470)	DSM-IV (P)	ADHD	PAF-oblique	1: IA 2: H/I	r = -.68
Healey et al. (1993)	USA; NC: Age 6-12, M=9.0, (B 43, G 42)	DSM-III-R (T)	ADHD	PCA-varimax	1: H/I 2: IA	
Holland et al. (1998)	USA; NC: Age K-12, (B 508, G 496)	DSM-IV (T & P)	ADHD	PCA-oblique	1: H/I 2: IA	r = .69

Table 1, continued

Hudziak et al. (1998)	USA; NC: Age 13-19, (G only, 1549 twins)	DSM-IV (P)	ADHD	PCA-oblique	1: H/I 2: IA	r = .51
Lahey et al. (1988)	USA; NC: Age K-5, N=667, Gender ratios not given	DSM-III (T)	ADHD	PCA-varimax	1: concentr'n & attent probs. 2: Over activity	
McBurnett et al. (2001)	USA; C: Age 3-18, (B 551, G 141)	DSM-IV (T & P)	ADHD	PCA-varimax	1: IA 2: H/I	
Pelham, Evans, et al. (1992)	USA; NC: Age 5-19, (B, 64)	DSM-III-R (T)	ADHD-ODD	PCA-varimax	1: ODD 2: H/I 3: IA	
Pelham, Gnagy, et al. (1992)	USA; NC: Age 5-14, (B, 931)	DSM-III-R (T)	ADHD-ODD	PCA-varimax	1: ODD 2: H/I 3: IA	
Rohde et al. (2001)	Brazil; NC: Age 6-12, M =9.3, (B 241, G 237)	DSM-IV (Cl)	ADHD	PCA-varimax	1: H/I 2: IA	
Weiler et al. (1999)	USA; NC: Age 6-12, M=9.1, (B 110 G 115). C: (B 86, G 38)	DSM-IV (T, P & Cl)	ADHD	PCA-varimax	1: H/I 2: IA	
Wolraich et al. (1998)	USA; C: Age 6-12, Sample a, (8257, Sample b, (4323), Gender ratios not given	DSM-IV (T)	ADHD-ODD	PCA-varimax	1: IA 2: H/I 3: ODD	
Yang et al. (2000)	Taiwan; NC: Age 6-12, M = 9.3, (B 241, G237)	DSM-III-R & DSM-IV (T)	ADHD	PCA-varimax	1; H/I 2: IA	

Note: NC = non clinical; C = clinical; B = boys, G = girls; * rater, (T) = teacher ratings, (P) = parent ratings, (Cl) = clinician, (Ad) = adolescent. * For varimax rotation there is no *r* between factors since the factors are orthogonal.

Interestingly, within the hyperactivity-impulsivity factor, the three IMP items ("does dangerous activities", "interrupts/intrudes", "blurts out answers") had substantial loadings on the ODD dimension, and overall there was a degree of overlap between the hyperactivity-impulsivity and ODD dimensions.

The second study (Pelham, Evans, et al., 1992) investigated a special education sample and extracted three factors, inattention, hyperactivity-impulsivity, and an ODD/CD factor containing two impulsivity items. Findings indicated a very similar pattern of results to that had prevailed for the sample of normal school children. The HYP items "difficulty remaining seated" and "fidgets", and the IA item "fidgets" loaded on both factors. As well four H/I items "interrupts/intrudes", "does dangerous activities", "blames others", and "deliberately annoys others" loaded on the ODD dimension also. Taken together the results in these two studies suggested that some of the symptoms purported to reflect the dimensions of inattention and hyperactivity-impulsivity are not clear indicators of their dimensions. Also, some of the symptoms purported to reflect hyperactivity-impulsivity are closely associated with the ODD symptoms.

As shown in Table 1, there is one study based on DSM-IV. This study (Wolraich et al., 1998) used teacher ratings and included both boys and girls. Three factors were extracted, the first two representing the inattention and hyperactivity-impulsivity dimensions and the third the ODD dimension. The inattention factor (52.8%) and the hyperactivity-impulsivity factor (33.5%) accounted for the bulk of the variance. Within the hyperactivity-impulsivity factor one HYP item ("fidgets") cross-loaded on the inattention factor. There was some evidence of several ODD items ("argues with adults", "deliberately annoys others", "blames others for his/her mistakes", "touchy or easily annoyed by others") cross-loading on both the ODD and hyperactivity-impulsivity factors.

3 . 3 . 5 EFA clinic sample studies of ADHD symptoms only based on the different DSM editions

There have been no DSM-III-R studies using clinical samples. The single DSM-III study (Lahey et al., 1988) has provided support for the DSM-IV factorial structure of inattention and hyperactivity-impulsivity. All IA items loaded on one factor and all HYP items loaded on a second factor. The IMP items did not form a separate factor but loaded variously on the other two factors. For DSM-IV, there have been two clinical studies based on samples of United States children (McBurnett, Pfiffner, & Frick, 2001; Weiler et al., 1999) and both confirmed the DSM-IV factor structure. Both studies used teacher, and parent ratings and included both boys and girls in their samples. The Weiler et al. (1999) study revealed that no symptoms cross-loaded. By contrast, McBurnett et al. (2001) found the H/I items loading only on their own factor, whereas two of the IA items ("difficulty organising activities", "loses things") had substantial loadings on both factors.

3 . 3 . 6 EFA clinic sample studies of ADHD-ODD/CD symptoms based on the different DSM editions

There are no known published studies based on DSM-III or DSM-IV. As shown in Table 1 there is one DSM-III-R study (Bauermeister, 1992) that examined ADHD and ODD symptoms. This study included both boys and girls and obtained scores based on teacher ratings of two different age groups (4-5, 6-

13) of Puerto Rican children. When the ADHD symptoms were examined independently, this study yielded evidence of a single factor structure including all ADHD symptoms for the 4-5 year-olds, and a two-factor structure of inattention and hyperactivity-impulsivity for the other age group. The authors indicated that the factor differences between the different age groups could have been due to the heterogeneity of symptom presentation in the younger children in the 4-5 age group.

3.3.7 Comparative summary of EFA studies for ADHD symptoms only, and ADHD-ODD symptoms, based on the different DSM editions

The EFA evidence pertaining to DSM-III is extremely limited. For both normative and clinic samples, it appears to provide more support for the DSM-IV two factor model of inattention and hyperactivity-impulsivity rather than a three factor model of inattention, hyperactivity, and impulsivity as suggested by the DSM-III guidelines. With respect to the data from DSM-III-R and DSM-IV studies for the ADHD symptoms only, the evidence is mainly from normative samples. Studies across many countries with normative samples have provided consistent evidence of the dual dimensional structure of inattention and hyperactivity-impulsivity as outlined in DSM-IV, rather than the undimensional structure as espoused by DSM-III-R, or the tripartite structure as suggested by the DSM-III diagnostic criteria. Finally, as shown by Table 1, several DSM-IV normative studies have shown intercorrelations between the inattention and hyperactivity-dimensions to range between .51 to .77, indicating that both core dimensions appear to be substantially correlated.

Although, in general, within the normative studies the inattention symptoms and the hyperactivity-impulsivity symptoms have loaded on their respective factors, there was also some evidence of inattention and hyperactivity-impulsivity symptoms loading on both factors. The data is inconsistent in terms of the specific symptoms loading on both the inattention and hyperactivity-impulsivity dimensions. Given this, it is suggested that such results may have occurred as a result of sampling variability.

Taken together, it can be argued that both the normative and clinic sample studies of the ADHD symptoms provide strong support for the inattention and hyperactivity-impulsivity factor structure of DSM-IV rather than the different models proposed by DSM-III and DSM-III-R. This view is further supported by studies that have included both ADHD and ODD and/or CD symptoms. The latter studies have also supported separation of the hyperactivity-impulsivity dimensions from the ODD/CD dimensions.

3 . 4 Confirmatory factor analysis

It was noted earlier that more recent studies have attempted to examine the construct validity of the ADHD symptoms using confirmatory factor analysis (CFA). EFA techniques are rapidly being superseded by CFA procedures because EFA defines relationships in only the most general way. EFA makes minimal assumptions about the organisation of the data and utilises mathematical criteria to explore the potential structure of the data. By contrast, CFA techniques employ substantive criteria to test or confirm pre-specified relationships in such a way that the overall quality of the factor solution and the specific parameters (e.g., factor loadings) composing the model are tested. A summary of the results from CFA studies is provided in Table 2.

3.4.1 CFA normative sample studies of ADHD symptoms only based on the different DSM editions

As shown by Table 2, to date there has been only a handful of studies that have examined the factor structure of ADHD with normative samples. No CFA studies have been based on either DSM-III or DSM-III-R. There have been four studies based on the DSM-IV ADHD symptom list, three United States and one Australian, and all samples included both boys and girls. Two of the United States studies by the same team alternatively obtained teacher ratings (DuPaul et al., 1997) and parent ratings (DuPaul et al., 1998), while the third (Collett, Crowley, Gimpel, & Greenson, 2000) obtained parent ratings only. The Australian study obtained teacher, and parent ratings (Gomez, Harvey, Quick, Scharer, & Harris, 1999).

With respect to the studies by DuPaul et al. (1997, 1998), teacher and parent data were alternatively used to test two factor models for the organisation of the DSM-IV ADHD symptoms. The first model comprised all 18 ADHD symptoms, and the second model comprised the inattention symptoms as one factor, and the hyperactivity-impulsivity symptoms as a second factor. In both studies the two-factor model resulted in a significant increase in fit over the one-factor model. For both teacher and parent data, the intercorrelation between the inattention and hyperactivity-impulsivity factors was very high, with teacher ratings being .94 and parent ratings .92. The remaining United States study (Collett et al., 2000) also confirmed the DSM-IV two-factor model for the ADHD symptoms.

In the Australian study (Gomez et al., 1999) which used teacher, and parent data, three factor models were compared; all items in one factor, inattention and hyperactivity-impulsivity as two separate factors, and inattention, hyperactivity, and impulsivity as three separate factors. For both teacher and parent ratings, the two and three-factor models indicated a significantly better fit than the one-factor model, while the three-factor-model indicated a marginally better fit than the two-factor model. The parent data provided a marginally better fit than the teacher data. For all subjects, for the two-factor model, the correlation between inattention and hyperactivity-impulsivity was .68 and .75 for teachers and parents respectively. For the three-factor model, the correlations were respectively, inattention and hyperactivity .77, inattention and impulsivity .64, and hyperactivity and impulsivity .86. However the authors have further argued that, on the basis of the high inter-correlation between the impulsivity and hyperactivity factors within the three-factor model ($r \neq .84$ for all ratings), that the two-factor model as represented in DSM-IV is a more appropriate model to fit the data.

3 . 4 . 2 <u>CFA clinic sample studies of ADHD symptoms only based on the different DSM editions</u>

To date there are no known published CFA studies that have separately examined the ADHD symptoms with samples of clinical children.

3 . 4 . 3 CFA normative sample studies of ADHD-ODD/CD symptoms based on DSM-III-R diagnostic criteria

There are no known CFA studies based on DSM-III. As shown in Table 2, there are two DSM-III-R studies of mainly primary school-age children by the same team (Burns, Walsh, Owens, et al., 1997, Burn, Walsh, Patterson, et al., 1997). The former study utilised teacher ratings, and the latter study utilised parent ratings. Both studies included both boys and girls. Both studies were designed to test a single model of the disruptive behaviour disorders comprising inattention, hyperactivity-impulsivity, ODD, and CD as four separate factors. As hypothesised, the data from both the teacher and parent studies supported this four-factor model. For teacher ratings, the correlations between the inattention factor and hyperactivity-impulsivity was quite substantial (.74). The inattention items had a significant correlation with their own dimension and showed good internal validity. By contrast, two hyperactivity-impulsivity items ("difficulty remaining seated", "fidgets") failed to show discriminant validity with the inattention dimension.

For parent ratings, the correlations between the inattention factor and the hyperactivity-impulsivity factor were strong (.80). The IA item "does not listen" failed to show discriminant validity with the hyperactivity-impulsivity dimension. The HYP item "difficulty remaining seated" failed to show discriminant validity with the inattention dimension. Three IMP items, "interrupts/intrudes", "does dangerous things", and "blurts out answers" also failed to show discriminant validity with the inattention dimension. Overall, comparison between the teacher and parent data from both studies by Burns and colleagues has shown that the DSM-III-R ADHD symptoms best fit a two-factor model commensurate to DSM-IV. In both studies the two-factor structure for ADHD held irrespective of age differences within the different samples.

3 . 4 . 4 CFA normative sample studies of ADHD-ODD/CD symptoms based on DSM-IV diagnostic criteria

Table 2 shows that there are two studies that included both boys and girls. Both studies used teacher ratings. One study used both primary and secondary children (Burns, Walsh, Owens et al., 1997) and one study used secondary school children (Molina, Smith, & Pelham, 2001).

The earlier study by Burns and colleagues (1997) examined 1711 children aged 4-15 years. This study was designed to test a single model comprising four separate factors of inattention, hyperactivity-impulsivity, ODD, and CD. Within the ADHD domain, each of the IA items was significantly more strongly related to the inattention factor than the hyperactivity-impulsivity factor. One H/I item, "fidgets" did not show discriminant validity with the inattention factor. The intercorrelation between the inattention factor and the hyperactivity-impulsivity factor was quite substantial (.78).

The other study by Molina et al. (2001) used two different age samples. Both samples of children (aged 11-16 years and 13-18 years respectively) were used to test three different factor models. The first model comprised the symptoms of inattention, hyperactivity, impulsivity, and ODD as one factor. The second model comprised the symptoms of inattention and hyperactivity-impulsivity as one ADHD factor, and ODD as a second factor. The third model comprised hyperactivity-impulsivity, inattention and ODD as three separate factors. The three-factor model provided the best fit for the data. This model, while confirming the DSM-IV dual dimensional structure of ADHD, nevertheless also found that the three latent factors were strongly and significantly correlated, with all correlations greater than .75 in both samples.

3.4.5 CFA clinic sample studies of ADHD-ODD/CD symptoms based on DSM-IV diagnostic criteria

As shown in Table 2, there are no known studies based on DSM-III or DSM-III-R. With respect to the DSM-IV symptom lists, there are two United States studies and both have included boys and girls. One study obtained both teacher, and parent ratings (Pillow, Pelham, Hoza, Molina, & Stultz, 1998), while the other study used parent ratings (Burns, Boe, Walsh, Sommers-Flanagan, & Teegarden, 2001).

In the Pillow et al. (1998) study, CFA analysis of the ADHD symptoms provided support for a three factor structure of the separate dimensions of inattention, hyperactivity, and impulsivity (DSM-III model) over the two factor model of inattention, and hyperactivity-impulsivity (DSM-IV) and one factor model with all inattention and hyperactivity-impulsivity symptoms grouped together (DSM-III-R).

The study by Burns et al. (2001) obtained maternal ratings for 742 outpatient clinic children and 91 children in treatment for ADHD. Five different models were evaluated for the organisation of the ADHD and ODD symptoms: (1) a single factor model, (2) an ADHD and ODD two-factor model, (3a) an inattention, hyperactivity-impulsivity, and ODD three-factor model, (3b) an inattention, hyperactivity-impulsivity, and ODD three-factor model in which the three IMP items cross-loaded on the ODD factor, (4) an inattention, hyperactivity, impulsivity, and ODD four-factor model. The authors indicated that Model 3a resulted in a good fit as well as a significantly better fit than model 2. However it was also acknowledged that there were only minimal differences between models 3a, 3b and 4. Model 3b was principally discounted because it only accounted for a small amount of the variance of the three impulsivity items relative to the hyperactivity-impulsivity and ODD factors. The authors concluded that the amount of variance accounted for was perhaps too small to allow the model with cross-loadings to be a more useful model for research purposes than the model without cross-loadings (3a). Model 4 was also discounted because the high inter-correlation between the hyperactivity and impulsivity factors made it difficult to identify unique correlates.

Overall, the results from both the Pillow et al. (1998) and Burns et al. (2001) studies attested to the separation of ADHD from ODD/CD, as two distinct but related factors. Although the results in both studies replicated the findings from earlier studies, in that the impulsivity items within the hyperactivity-impulsivity factor were found to cross-load on the ODD factor, both studies concluded that the present DSM-IV organisation of the ADHD symptoms provided the best fit for the ADHD symptoms when they are considered as one part (with ODD/CD as the second part) of a two-factor model for the childhood disruptive behaviour disorders.

Table 2

Summary of CFA Studies Based on DSM-III-R and DSM-IV Diagnostic Criteria

Author	Country & sample	Symptoms, diagn. criteria & rater	Extraction method	Models tested	Fit statistic					Correlations
					χ^2	CFI	GFI	RMSR	RMSEA	
Burns, Walsh, Owens, et al. (1997)	USA; NC: Sample 1: Age K-7, M=8.58 (B 722, G 723)	ADHD-ODD DSM-III-R (T)	Maximum likelihood	2F-ADHD, ODD 3F-IA, H/I, ODD 4F-IA, H/I, ODD, CD		.92	.87	.05		4 Factor model IA-H/I = .74 IA-ODD = .64 IA-CD = .39 H/I ODD = .69 H/I-CD = .41
	NC: Sample 2; Age 4-15, M=9.12, (B 862, G 849)	ADHD-ODD DSM-IV (T)		2F-ADHD, ODD 3F-IA, H/I, ODD 4F-IA, H/I, ODD, CD		.93	.87	.04		4 Factor model IA-H/I = .78 IA-ODD = .66 IA-CD = .53 H/I ODD = .80 H/I-CD = .63
Burns, Walsh, Patterson, et al. (1997)	USA; NC: Sample 1; Age 2-19, M=10.36, (B 1045, G 965)	ADHD-ODD DSM-III-R (P)	Maximum likelihood	2F-ADHD, ODD 3F-IA, H/I, ODD 4F-IA, H/I, ODD, CD		.94	.94	.04	.06	4 Factor model IA-H/I = .80 IA-ODD = .69 IA-CD = .50 H/I ODD = .70 H/I-CD = .65
	USA; NC:	ADHD-ODD	Maximum	2F-ADHD, ODD						4 Factor model

Table 2, continued

	Sample 2; Age 2-19, M=10.36, (B 1045, G 965)	DSM-III-R (P)	likelihood	3F-IA, H/I, ODD 4F-IA, H/I, ODD, CD		.95	.95	.04	.06	IA-H/I = .79 IA-ODD = .68 IA-CD = .49 H/I ODD = .72 H/I-CD = .67
Burns et al. (2001)	USA; C: Outpatient; Age, M=8.29, total sample = 91, (Gender ratios not given)	ADHD-ODD DSM-IV (P)	Maximum likelihood	1F-ADHD/ODD 2F-ADHD, ODD 3Fa-IA, H/I, ODD 3Fb-IA, H/I, ODD (with IMP cross-load on ODD) 4F- IA, HYP, IMP, ODD	2955 2258 1293 1257 1190	.72 .80 .90 .90 .91		.089 .078 .057 .055 .055		4 Factor model IA-H/I = .66 IA-IMP = .64 IA-ODD = .69 HYP-ODD = .67 IMP-ODD = .74
	C: Inpatient; Age, M=10.26, N=742 (Gender ratios not given)	ADHD-ODD DSM-IV (P)	Maximum likelihood	1F-ADHD/ODD 2F-ADHD, ODD 3Fa-IA, H/I, ODD 3Fb-IA, H/I, ODD (with IMP cross-load on ODD) 4F- IA, HYP, IMP, ODD	634 530 435 431 433	.64 .73 .81 .81 .81		.107 .096 .085 .084 .085		4 Factor model IA-H/I = .73 IA-IMP = .67 IA-ODD = .58 HYP-ODD = .69 IMP-ODD = .76
Collett et al. (2000)	USA; NC: Age, K-12, M=8.97, (B 265, G 307)	ADHD DSM-IV (P)	Maximum likelihood	2F-IA, H/I	332	.96	.89	.032	.082	
DuPaul et al. (1997)	USA; NC: Sample 1; Age 4-20,	ADHD DSM-IV (T)	Maximum likelihood	1F-ADHD 2F-IA, H/I				.06		IA-H/I = .94

Table 2. continued

	M=9.57, (B 2134, G 2470)									
DuPaul et al. (1998)	USA; NC: Age 4-19, M=10.30, (B 2054, G 1934)	ADHD DSM-IV (P)	Maximum likelihood	1F-ADHD 2F-IA, H/I				.06		IA-H/I = .92
Gomez et al. (1999)	Australia: NC: Age 5-11, (B 604, G 671)	ADHD DSM-IV (T & P)	Maximum Likelihood	T: 1F-ADHD 2F-IA, H/I 3F-IA, HYP, IMP	5167 1842 1189		.52 .84 .90	.060 .040 .041		2 Factor model IA-H/I = .68
				P: 1F-ADHD 2F-IA, H/I 3F-IA, HYP, IMP	2084 1058 861		.77 .90 .93	.054 .038 .034		2 Factor model IA-H/I = .75
Molina et al. (2001)	USA; NC: Sample 1, Age 11-16, M=13.0, (B 138, G 109)	ADHD-ODD DSM-IV (T)	Maximum likelihood	IF-ADHD/ODD 2F-ADHD, ODD 3F-IA, H/I, ODD	1107 840 272	.77 .84 .91		.08 .07 .06		3 Factor model IA-H/I = .77 IA-ODD = .75 H/I –ODD = .87
	Sample 2, Age 13-18, M=15.2, (B 95.5%, G 4.5%)			IF-ADHD/ODD 2F-ADHD, ODD 3F-IA, H/I, ODD	691 590 438	.67 .76 .88		.09 .09 .07		3 Factor model IA-H/I = .77 IA-ODD = .75 H/I –ODD = .87
Pillow et al. (1998)	USA; C: Age 5-15, (B 282)	ADHD DSM-IV	Weighted least squares	IF-ADHD 2F-IA, H/I	169 103	.88 .87			.120 .085	

Table 2, continued

	(T & P)		3F-IA, HYP, IMP	89	.95		.080
		Maximum likelihood	IF-ADHD	305	.68		.170
			2F-IA, H/I	145	.87		.110
			3F-IA, HYP, IMP	108	.91		.092

Note: NC = non-clinical, C = clinical; M = mean; T = teacher, P= parent; B = boys, G = girls; IA = inattention, H/I = hyperactivity-impulsivity, HYP = hyperactivity, IMP = impulsivity, ODD = oppositional defiant disorder, CD = conduct disorder. CFI = comparative fit index, GFI = goodness of fit index with higher values for both indices indicating a better-fit statistic; RMSR = root mean square residual, RMSEA = root mean square error of approximation, with lower values for both indices indicating a better fit statistic.

3.4.6 Comparative summary of CFA studies of ADHD symptoms only, and ADHD-ODD/CD symptoms, based on the different DSM editions.

There are no known CFA studies of ADHD symptoms only based on DSM-III, DSM-III-R, or DSM-IV for clinic samples. As well, for normative samples there have been no DSM-III or DSM-III-R studies. The data in Table 2 indicate a handful of DSM-IV studies. In these studies three different models have been tested with teacher and parent ratings for the structure and organisation of the ADHD symptoms. One model comprises all 18 ADHD items as a single factor (DSM-III-R), a second model comprises the inattention, and hyperactivity items as two separate factors (DSM-IV), and the third model comprises the inattention, hyperactivity, and impulsivity items as three separate factors (DSM-III).

For both teacher and parent data, the DSM-III-R single factor model (all ADHD items together) was found to be inappropriate. The DSM-IV two-factor model (IA and H/I) was found to provide a relatively similar fit to the DSM-III three factor model (IA, HYP and IMP). However, the two-factor model was considered to be a more appropriate model than the three-factor model because of the high intercorrelation between the HYP and IMP factors in the three-factor model that in one study was as high as .84. In the two-factor model, the intercorrelation between the IA and H/I factors ranged from .68 to .94, and this suggested that while the ADHD symptoms formed two factors, they nevertheless were highly related.

The CFA studies for both normative and clinic samples of ADHD-ODD/CD symptoms also supported the DSM-IV factor structure for the organisation of the ADHD symptoms. Both normative and clinic studies for teacher and parent ratings found a high degree of intercorrelation between the IA and H/I factors.

Overall, as shown by Table 1, similar to the findings noted earlier for the EFA studies, the findings mainly from CFA normative studies support the proposition that the IA and H/I dimensions are separate but substantially correlated dimensions.

Taken together, the results from the ADHD symptoms only, and ADHD-ODD/CD symptom studies, have suggested that the DSM-IV two-factor model of inattention and hyperactivity-impulsivity is an appropriate organisation for the ADHD symptoms.

3 . 4 . 7 Overall summary of studies examining the internal structure of the ADHD symptoms

Overall, EFA and CFA studies have supported the DSM-IV two-factor structure of inattention, and hyperactivity-impulsivity for the organisation of the ADHD symptoms. In particular, CFA studies have examined one factor (proximal to DSM-III-R), two-factor (proximal to DSM-IV), and three-factor (proximal to DSM-III) models. Uniformly the one-factor model has been rejected, and generally there have been marginal differences between the two and three-factor models. However, due to the very high correlation between the hyperactivity and impulsivity factors within the three-factor model, a two-factor model has been favoured over a three-factor model.

Although many of the EFA and CFA studies reported a pattern of symptom cross-loading of inattention and hyperactivity-impulsivity symptoms on the inattention and hyperactivity-impulsivity dimensions, it was clear that there were no systematic findings of cross-loadings for any of the ADHD symptoms

Overall therefore there is strong support for the view that the ADHD symptoms comprise the two dimensions of inattention and hyperactivity-impulsivity. While there is support for the separation of items comprising these dimensions, the data also indicate a high correlation between the inattention and hyperactivity-impulsivity dimensions. These conclusions provide some support for the construct validity of ADHD symptoms as presented in DSM-IV. However this argument also needs to be regarded with some caution in view of a number of limitations with past studies.

3 . 5 Limitations of the data in EFA/CFA studies for the ADHD structure.

As will be clear by now, the preceding review of existing EFA and CFA studies has revealed that the data has been based overwhelmingly upon normative samples. Indeed, to date there have been no separate studies of clinical samples of ADHD only children, based on DSM-IV criteria. Thus the existing data on the construct validity of the ADHD symptoms derived from EFA and CFA studies must be viewed as limited. Given this concern, it is argued here that support for the two-factor model of the inattention and hyperactivity-impulsivity dimensions (or indeed any model) needs to be established for ADHD children with a clinical diagnosis, as the diagnostic symptoms are directly relevant to this group more than any other group. Accordingly, both EFA and CFA studies are needed in this respect.

While the results from EFA and CFA studies have supported the DSM-IV factor structure, the consistent finding of a high degree of intercorrelation between the IA and H/I symptoms indicates that there is a need for further clarification of the relationship between the IA and H/I dimensions.

According to Gomez, Burns, Walsh, and DeMoura (2003), the high correlations between IA and H/I factors in the two factor model CFA studies (for teacher or parent rating scales) may be understood in terms of trait and source effects. More recently CFA has been used to model a multitrait (IA and H/I) and multimethod/source (teachers and parents) design to determine the amount of trait, source, and error variance in the ADHD symptoms. Rowe and Kandel (1997) make the distinction between trait and source effects clear in the following quote about parent and teacher ratings of child behaviour problems.

> . . . rarely have attempts been made to estimate systematically the respective extent of the shared [trait] view and the individual [source] view in informant's ratings . . . the shared view refers to the identical perception of children's trait characteristics that are exhibited to different informants (e.g., parents and teachers, children and parents). The shared view may represent a child's trait that generalises cross observers and contexts, that is, a trait effect independent of method of data collection. In contrast, the individual view refers to the perception of a child's trait that is unique to a particular source. . . . the individual view is mathematically uncorrelated with the shared view of the child. The issue then is one of separating trait (shared) variance from individual (method) variance" (pp. 265-266, emphasis in original).

The notion that method/source effects may have contributed to the high correlation between the inattention and hyperactivity-impulsivity factors was examined in a study that used CFA multitrait-multisource (MTMS) analysis involving two normative samples (Gomez et al., 2003). It should be noted that, based on Campbell and Fiske (1959) the more common name is multitrait-multimethod (MTMM), however this study used multiple sources (teachers and parents) and a single method (same rating scale). Given that the procedures adopted by Gomez et al. (2003) will be replicated in Study 1 of this thesis, generally the design will be referred to as multitrait-multisource (MTMS) to indicate that there are multiple sources and a single method.

In the Gomez et al. study, one sample involved parent and teacher ratings of Australian primary school children, while the other sample involved parent and teacher ratings of Brazilian primary school children. For both samples, the results were remarkably consistent. The results for both samples showed much more method or source effects than trait effects (i.e., the symptoms contained more source variance than trait variance). Indeed the effect of source variance can be seen in that the intercorrelation between the IA and H/I factors for teachers, and parents was low to moderate and ranged between .33 and .46 across the samples in the different countries.

A subsequent MTMS study by the same research team (Burns, Walsh, & Gomez, in press), involved ratings of 360 Australian elementary school children included in their first study. This study evaluated the stability of the trait, source and error variance in the ADHD inattention and hyperactivity-impulsivity symptom dimensions over a three-month interval. They found that the amount of trait and source variance remained stable over this interval. Taken together the results of these studies suggest that the high correlation between the IA and H/I factors found in previous EFA and CFA studies may have arisen from source effects. The low correlation between the IA and H/I factors found in the studies after removing source and error effects supports the divergent validity of the inattention and hyperactivity dimensions, and therefore their independence.

However this conclusion needs to be viewed cautiously as the two studies to date (Burns et al., in press; Gomez et al., 2003) were based on normative samples. Thus it cannot be assumed with all certainty that the inattention and hyperactivity-impulsivity dimensions would have the same level of independence in children with ADHD. Clearly there is a need for such studies involving ADHD children.

Given this, there were two major aims in Study 1 reported in the next chapter. Firstly, the study examined the construct validity of the organisation of the DSM-IV ADHD symptoms in children with ADHD. Second, it examined the construct validity and discriminant validity of DSM-IV ADHD symptoms and the trait, source and error variance of these symptoms in the ADHD children.

In summary, this chapter has reviewed the evidence from the EFA and CFA studies for the internal structure of the ADHD symptoms in DSM-III, DSM-III-R, and DSM-IV respectively. As the evidence has shown, both EFA and CFA studies of teacher and/or parent ratings of normative and clinical samples, have found the DSM-IV two factor model of inattention, and hyperactivtiy-impulsivity as an appropriate organisation of the ADHD symptoms.

However, an important limitation has been noted with respect to the design of the existing EFA and CFA studies that have examined the factor structure of the ADHD symptoms. To date no factor analysis study has examined children with a clinical ADHD diagnosis, so at present there is no way to determine whether the existing findings for normative and clinical samples would apply to children with ADHD.

In addition, an area of critical importance that has only very recently been considered is the notion of a radically alternative explanation for the high correlation between the inattention and hyperactivity-impulsivity dimensions found in past EFA and CFA studies. Although in the past the high degree of correlation between the IA and H/I factors has been widely interpreted as an indication that ADHD is comprised of two separate but highly correlated factors, it is only very recently that researchers have questioned whether the correlation between the IA and H/I factors may be due to method or source effects (as systematic effects related to the perceptions of the raters), rather than trait effects (as assumed agreement between raters about the symptoms). Apart from two studies, none of the EFA and CFA studies has examined the construct validity of ADHD in terms of trait, source, and error variance. The two existing studies that have examined this were both on normative samples, so clearly studies with ADHD children are needed to ascertain whether the findings for normative samples would apply to ADHD children.

CHAPTER 4

EXPLORATORY AND CONFIRMATORY FACTOR MODELS, AND TRAIT, SOURCE AND ERROR VARIANCE IN ADHD SYMPTOMS OF CHILDREN WITH ADHD

4 . 1 Introduction

Chapter 3, provided a literature review and analysis of the factor analysis studies concerning the structure of the ADHD symptoms. As previously shown in chapter 2, the changes inherent in DSM-IV ADHD diagnostic criteria resulted mainly from factor analysis studies and a nation-wide field trial. It was demonstrated in Chapter 3 that the numerous EFA studies using the ADD and ADHD symptoms in DSM-III and DSM-III-R respectively, supported a two-factor structure for both clinic-referred and normative samples. As well, it was also shown that more recent studies have used CFA in preference to EFA to evaluate the structural organisation of teacher and parent ratings of DSM-IV ADHD symptoms. These studies have consistently found that a two-factor model consisting of inattention (IA) and hyperactivity plus impulsivity (H/I) factors (comparable to the way DSM-IV has organised the ADHD symptoms) provides a better model for the organisation of parent and teacher ratings than a one factor model of all 18 DSM-IV ADHD symptoms together (comparable to the way DSM-III-R has organised the ADHD symptoms).

Moreover, as indicated in Chapter 3, at least two studies (Burns et al., 2001; Gomez et al., 1999) have compared these one and two-factor models with a three-factor model, involving separate factors for the inattention (IA), hyperactivity (HYP), and impulsivity (IMP) symptoms (comparable to the way DSM-III has organised the ADHD symptoms). Both these studies found that there was a good fit for both the two and three-factor models, compared to the one-factor model. Although the three-factor model showed marginally better fit than the two-factor model, both groups of researchers argued in favour of the two-factor model. This was because of the extremely high correlation between the HYP and IMP factor.

Overall, therefore, there is support for organising the current DSM-IV symptoms in the two dimensions of inattention and hyperactivity-impulsivity. However, as indicated by the results in chapter 3, some caveats prevail to this proposition. Based on close perusal of the past studies, it is clear that although clinical groups have been studied, to date no study has examined the organisation of the ADHD symptoms in a group of children with a primary diagnosis of ADHD. It is argued here that support for the two factor model (or indeed any model) needs to be established for ADHD children, as the diagnostic symptoms are directly relevant to this group more than any other group. Thus both EFA and CFA studies of children with an ADHD diagnosis are needed to establish the true structural organisation of DSM-IV ADHD symptoms. In view of this, this study attempts to overcome this limitation, in that participants in this study were children with a confirmed ADHD diagnosis.

Also identified in chapter 3, as a further limitation to the validity of the dual factorial structure in DSM-IV, is the consistent pattern of high correlations between the IA and H/I factors in the EFA and CFA data. In particular, past CFA studies have found high correlations between the IA and H/I factors, comprising the two-factor model. As stated in the preceding chapter, this high correlation between the IA and H/I factors may not necessarily only pertain to similarities between symptoms within the different factors of IA and H/I. As noted in the last chapter, as all past CFA studies have produced results based on a single source (teacher or parent) rating of a child's behaviour, then the use of a single source may be the reason for the high correlation between the IA and H/I factors. Thus the high *r* between the IA and H/I factors in past studies may be due to source effects that can be discerned from CFA MTMS designs.

As previously noted, a recent study used a CFA MTMS design to examine the convergent and discriminant validities, and the amount of trait, source and error variance in the DSM-IV ADHD symptoms for two normative samples (Gomez et al., 2003). One sample involved teacher and parent ratings of Australian primary school children, while the other sample involved teacher and parent ratings of Brazilian primary school children.

Two MTMS analyses were used. First, the 18 ADHD symptoms were analysed, and second, the ADHD symptoms were analysed as parcels (i.e., 2 parcels for IA, and 2 parcels for H/I for the two sources). The authors reported that for both types of MTMS analysis, the DSM-IV two-factor model provided a good fit in an absolute sense, as well as a significantly better fit than a one factor model. In addition, similar results occurred in both studies with most of the ADHD symptoms containing more source than trait variance, thus providing weak evidence for the convergent validity of the symptoms. The finding in both studies of low to moderate correlations between the IA and H/I factors suggested good discriminant validity of the traits, however the low amount of trait variance in the symptoms qualified the importance of the low correlation between the IA and H/I traits.

In a subsequent study, the same research team found that the amount of trait and source variance in the ADHD symptoms found in their earlier study, remained stable over a three-month interval (Burns et al., in press). However it can be argued that, given that these results pertain to samples of normative children, it is uncertain if their findings are applicable to children with an ADHD diagnosis. Clearly there is a need to use CFA MTMS methods to test children with a clinical ADHD diagnosis in order to establish the convergent and discriminant validities, and the trait, source and error variance in the ADHD symptoms.

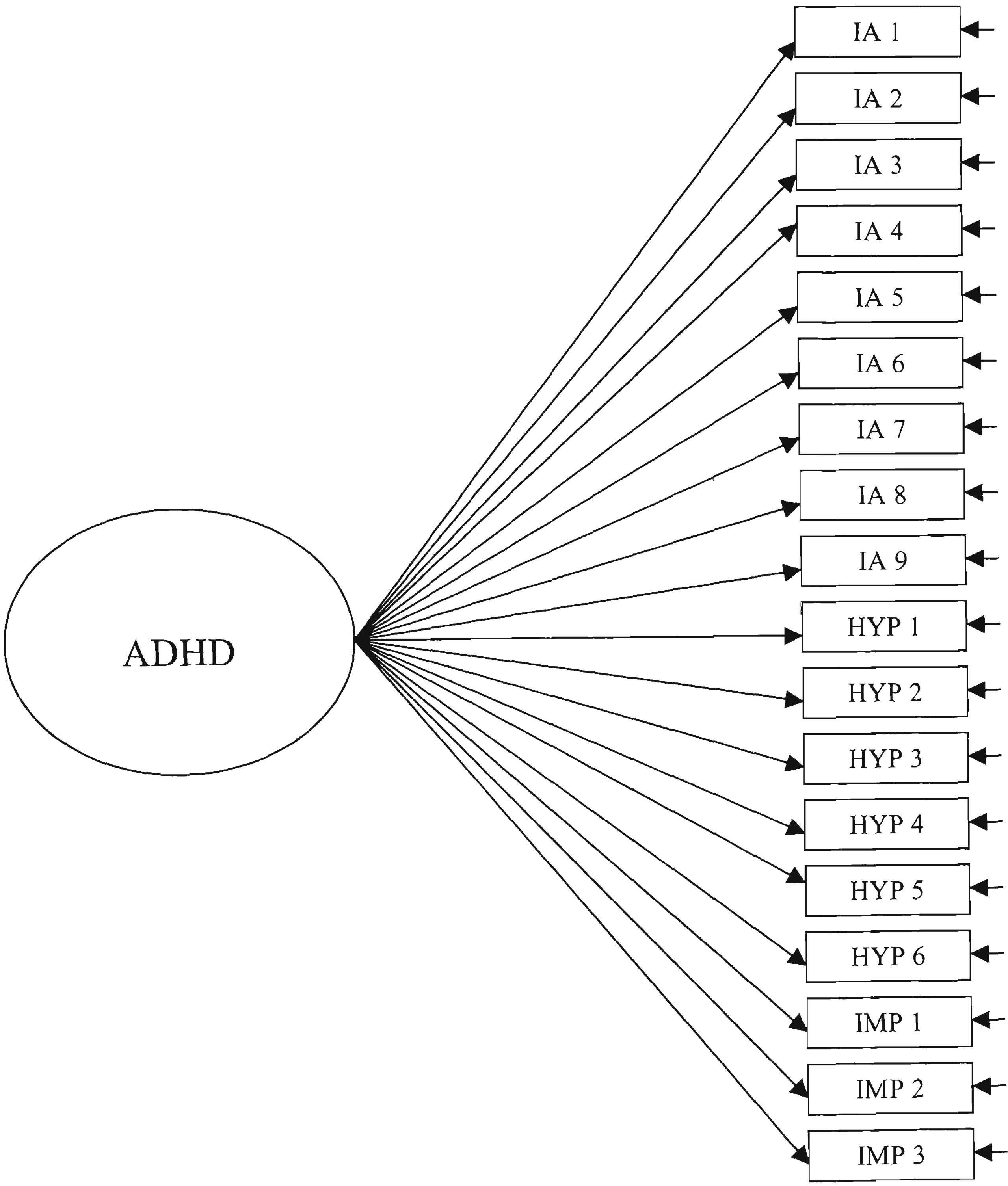
The aims of this study were outlined in the previous chapter, and above. In recapitulation, the first aim of the study is to use samples of children with a clinical diagnosis of ADHD to test the ADHD factor structure in DSM-IV.

Specifically referring to CFA procedures, the structural organisation of the ADHD symptoms will be tested in line with the ways in which DSM-III, DSM-III-R and DSM-IV have directed clinicians and researchers to consider the core symptoms of inattention, impulsivity and hyperactivity for diagnosis of the disorder. Three different models will be tested. These models are shown in Figures 1, 2, and 3. Model 1 comprised all 18 DSM-IV items together as a single factor (i.e., comparable to how ADHD symptoms are considered for diagnosis in DSM-III-R). Model 2 had two factors. One factor comprised all 9 IA items, while the other factor comprised the 6 HYP and the 3 IMP items together (i.e., comparable to how ADHD symptoms are considered for diagnosis in DSM-IV). Model 3 had three factors, with the IA items in one factor, and the HYP and IMP items grouped into two separate factors (i.e., comparable to diagnosis in DSM-III). In line with the way DSM-IV has organised the ADHD symptoms (and also existing data), it is hypothesised that there will be support for the two-factor model.

The second aim of the study was to use CFA MTMM procedures to evaluate the construct validity (both convergent and discriminant validity) of the ADHD-IA and ADHD-H/I symptoms. As already noted, studies with ADHD samples are needed because the earlier findings with population-based samples (Burns et al., in press; Gomez et al., 2003) may not generalise to a clinical sample.

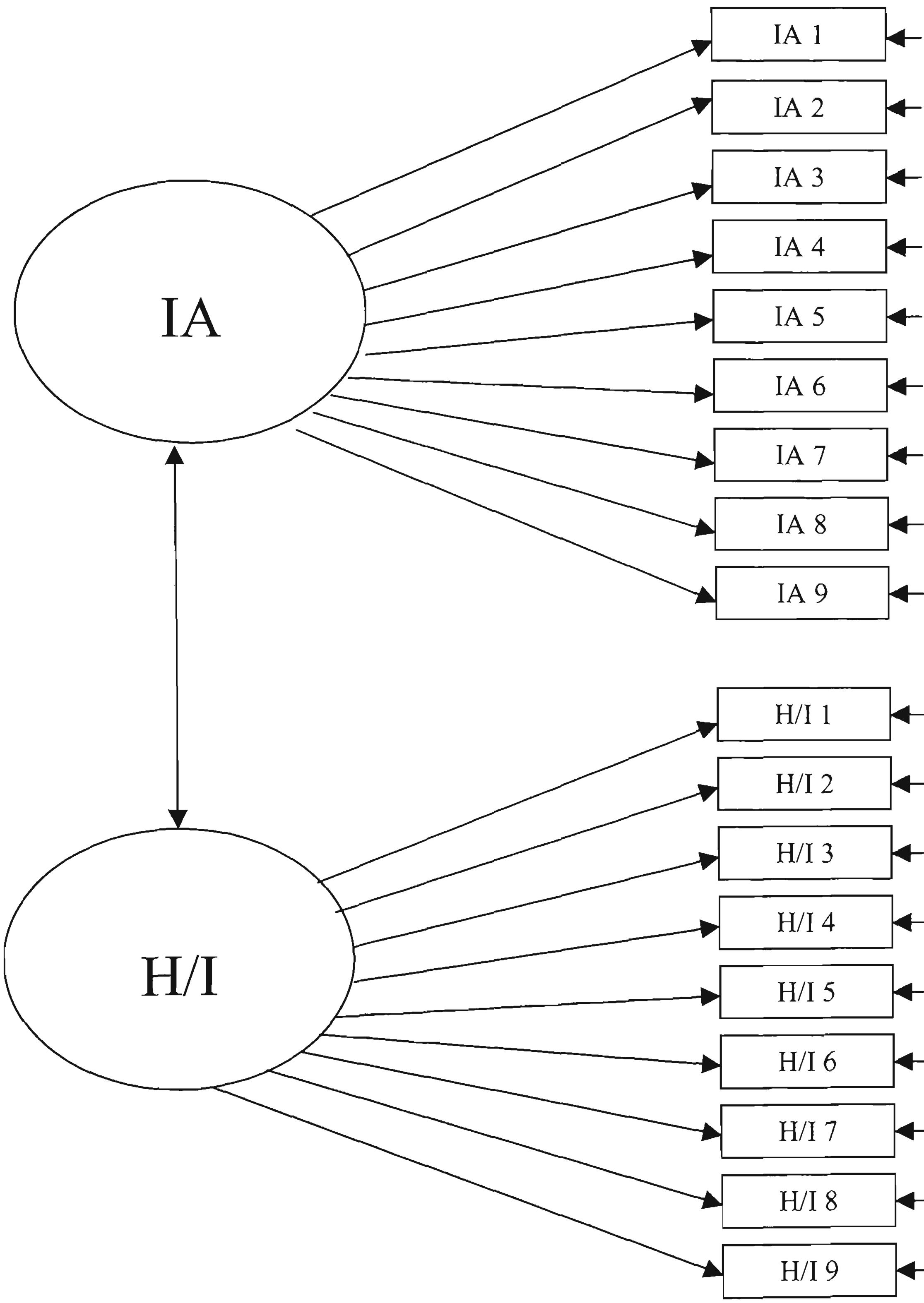
Two commonly used MTMS procedures are correlated uniqueness method (CU) and the correlated trait/correlated method (CT-CM). The CU approach has been considered to produce more convergent and admissible factor solutions than the CT-CM approach that has known underidentification problems (Kenny & Kashy, 1992). Nonetheless, Lance, Noble, and Scullen (2002) has described a series of theoretical and substantive limitations of the CU approach. First, the CT-CM method has a better theoretical foundation than the CU method. The CU method for estimation of method variance, and relationships among models is deemed less effective than the CT-CM method.

One particular weakness of the CU approach occurs when there are correlations among the methods or sources. As indicated in the study by Gomez et al. (2003), this is a problem because the CU approach assumes that the method or source effects are orthogonal. That is, teacher, parent or child self-ratings are not correlated (see Kenny & Kashy, 1992).



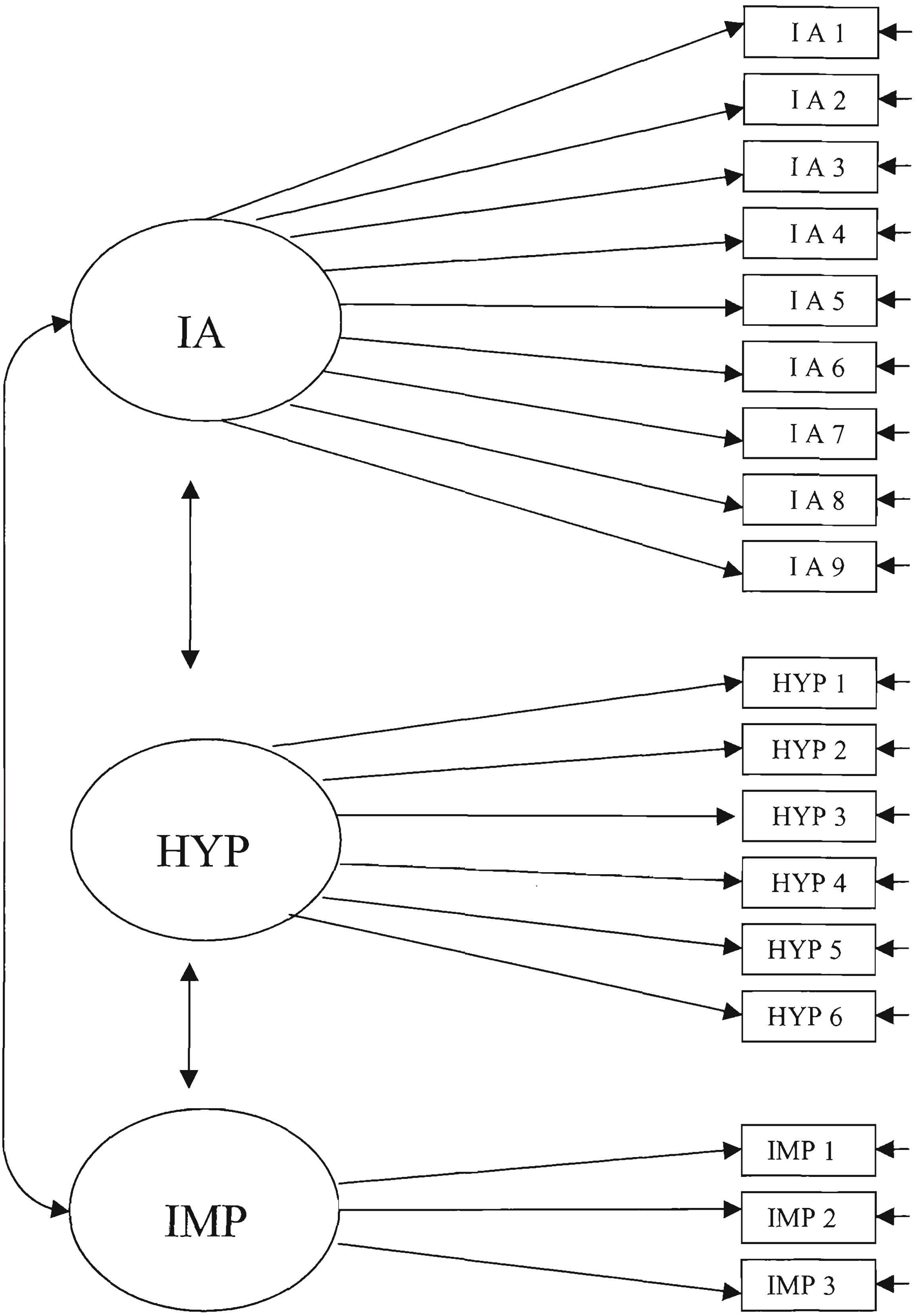
Note: IA = inattention, HYP = hyperactivity, IMP = impulsivity

Figure 1. Path model of one-factor model of DSM-IV ADHD symptoms.



Note: IA = inattention, H/I = hyperactivity-impulsivity

Figure 2. Path model of two-factor model of DSM-IV ADHD symptoms.



Note: IA = inattention, HYP = hyperactivity, IMP = impulsivity

Figure 3. Path model of three-factor model of DSM-IV ADHD symptoms

That is, teacher, parent or child self-ratings are not correlated (see Kenny & Kashy, 1992). Gomez et al. (2003) add further, that when the data do not support this assumption, the CU approach results in the correlations among the sources artificially inflating the convergent validity (i.e., increasing the trait variance) and thereby artificially inflating the correlations among the traits, thus artificially decreasing the discriminant validity. Lance et al. (2002, pp. 232-233) illustrates this problem, and refers to the study by Crystal, Ostrander, Chen, and August (2001) as a further exemplification of the problem. Lance et al. (2002) have recommended that "the CT-CM be regarded as the generally preferred model and that the CU model be invoked only when the CT-CM approach fails" (p. 228). Thus the CT-CM approach has been chosen for use in this study (see Lance et al., 2002, Table 6 for a more detailed analysis of the comparative merits of CT-CM and CU models). In summary, the application of CFA to MTMS matrices has provided quantitative procedures to test the convergent and discriminant validity of measures as well as determine the amount of trait, source (method), and error variance in each measure (Lance et al., 2002).

The convergent and discriminant validities of the ADHD symptoms were examined at both the matrix and individual parameters level. Symptom parcels were used, with two IA parcels and two H/I parcels. The even numbered IA items (i.e., 2, 4, 6, 8) formed parcel 1, and the odd numbered items (i.e., 1, 3, 5, 7, 9) formed parcel 2. For H/I, the even numbered items (i.e., 2, 4, 6, 8) formed parcel 1, and the odd numbered items (i.e., 1, 3, 5, 7, 9) formed parcel 2.

There are several reasons for item-parcel analysis. As the sample size was small, using the individual symptoms meant an unusually low subject to parameter ratio. Using the parcels gives a much higher subject to parameter ratio (cf. Bentler, 1995; Hu, Bentler, & Kano, 1992). Second, item parcel analysis reduces any high levels of skewness and kurtosis thereby reducing the prospect of any violation of the multivariate normality assumption of CFA. Third, and very critically, the use of item-parcels decreases the amount of error variance in the ADHD symptoms. This should occur because presumably each symptom taps some independent component of trait or source variance, and, when the items are added to produce summary (parcel) scores there should be a decrease in the error variance for the parcels relative to the individual symptoms (see Gomez et al., 2003). Finally, it has also been suggested that item-parcel analysis rather than individual symptom analysis should more closely approximate the summary (total) scores on the IA and H/I dimensions used to understand ADHD (i.e., risk factors, associated features, and treatment effects associated with the total scores on the IA and H/I ratings of teachers and parents (Gomez et al., 2003).

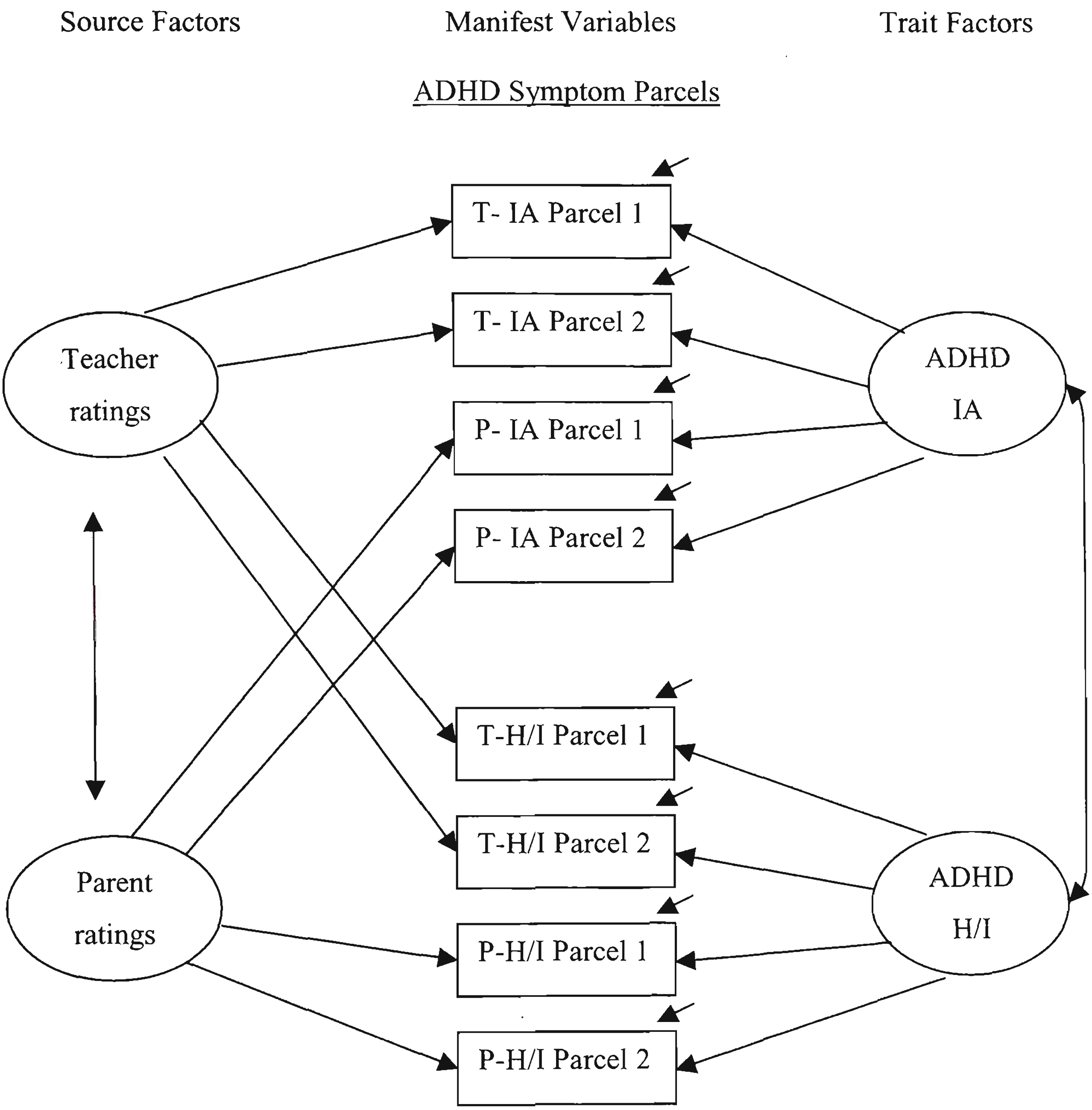
More specifically, CFA procedures were used to model multiple traits (i.e., ADHD-IA and ADHD-H/I) assessed by multiple sources (i.e., teachers and parents). Figure 4 shows the postulated model (Model 1). This model involves two latent trait factors (IA and H/I) and two latent source factors (teachers and parents). There were 8 manifest variables, 4 ADHD symptom parcels for teachers and 4 ADHD symptom parcels for parents. Each of the 8 manifest variables also has an error component. This model involved freely correlated traits and freely correlated sources.

To test the convergent and discriminant validity of traits and sources, the fit for this model was compared to a nested series of more restrictive models as suggested by Byrne (1998). Model 2 involved no traits and freely correlated sources, Model 3 involved perfectly correlated traits and freely correlated sources, and Model 4 involved freely correlated traits and perfectly correlated sources. To test the convergent validity of the traits, Model 1 is compared to Model 2. To test the discriminant validity of the traits, Model 1 is compared with Model 3, and, to test the discriminant validity of the sources, Model 1 is compared to Model 4. A significantly better fit for Model 1 over the other models would support the convergent and discriminant validities, as appropriate. At the individual parameters parcel level Model 1 is examined. The ideal outcome is for the two trait factors to be minimally correlated with each other (supporting the discriminant validity of traits), for the two source factors to be moderately to minimally correlated with each other (supporting discriminant validity of sources), and for each parcel to have a significant and substantial trait variance and also more trait than source variance (supporting convergent validity of parcels) (Gomez et al., 2003).

Such ideal outcomes would provide strong evidence for the construct validity of the ADHD symptom parcels, as measured by teacher and parent rating scales. By contrast, lower levels of trait variance comparative to higher levels of source variance for each symptom parcel would raise concerns about the construct validity of the ADHD symptom parcels.

4 . 2 Hypotheses of the study

The first aim of the study was to use standard CFA procedures to test 3 models of the ADHD symptoms for teacher and parent ratings. It is hypothesised that, consistent with past data, there will be support for the two-factor model and three-factor model.



Note: IA = inattention; H/I = hyperactivity/impulsivity; T = teacher; P = parent.

Figure 4. Path diagram of the postulated multitrait-multisource model (Model 1).

The second aim of the study was to examine the convergent and discriminant validities, and the amount of trait, source and error variance among the DSM-IV ADHD symptoms. Based on the findings of the very few available studies (Burns et al., in press; Gomez et al., 2003) it is hypothesised that there will be greater source than trait effects for teacher and parent ratings of the ADHD symptoms.

4 . 3 Method

4 . 3 . 1 Participants

The 223 ADHD participants in the study comprised 193 males and 30 females between 6 and 13 years of age. The mean age was 10.81 (Standard Deviation = 3.91). All subjects were recruited on the basis of established prior diagnosis of DSM-IV ADHD (Inattentive, Hyperactive/Impulsive, or Combined Subtypes). In addition, for inclusion in the study, it was necessary to re-establish their ADHD status, based on parent interview. This was done using the ADHD section of Barkley's Clinical Interview Schedule (1998b). Virtually all cases involved in the study were still taking medication for ADHD at the time of this study. For the interview, parents were asked to describe their children's behaviour when they were not taking medication. Diagnosed ADHD children were recruited through a paediatric medical clinic and a child clinical psychology clinic.

The paediatric medical clinic was located at Geelong, a large provincial city about 90 kilometres from Melbourne in the State of Victoria. The clinic made available the names of 330 children diagnosed as ADHD since early 1995. According to the clinician at this clinic, all cases were diagnosed through a structured clinic interview, based on DSM-IV ADHD diagnostic criteria, involving parents, with "input" from teachers, whenever possible. Of the 330 children available, 195 children's parents agreed to participate. The child psychology clinic was located at Melton, an outer western suburb of Melbourne. The clinic made available the names of 85 children diagnosed as ADHD. Of the 85 children available, 73 children's parents agreed to participate.

All cases were diagnosed through a combination of structured clinic interview, based on DSM-IV ADHD diagnostic criteria, as well as appropriate parent and teacher child behaviour rating scales, including the parent-rated Child Behavior Checklist (CBCL) and the teacher-rated Teacher Report Form (TRF) (Achenbach, 1991). Most children receiving the ADHD diagnosis in this clinic would have had T scores of at least 70 (the clinical cut-off level) on the Attention Problem Factor of both the CBCL and the TRF.

In all 223 matched ratings for the DSM-IV ADHD Rating Scale were obtained from teachers and parents. The occupational status of the children's parents based on the Australian Standard Classification of Occupations (ASCO, 1996) was as follows; professional 22.97%, managerial 3.66%, clerical 17.43%, skilled trades 4.58%, unskilled trades 30.27%, allied trades 10.1%, pensioner and unemployed 11%. Based on a rating scale of "1 = professional" to "7 = pensioner and unemployed" the parent mean occupational status was 3.96 which equated as a borderline between clerical and skilled trades and might be regarded as lower middle class in occupational status.

4.3.2 Justification of sample size

When using structural equation analysis, the number of subjects is an important consideration. In this respect there is no generally accepted approach. Some researchers have suggested a sample size of 10 times the number of free model parameters (Bentler, 1995; Hu et al., 1992). Other researchers have proposed different guidelines for sample size. For example it has been suggested that the minimum sample size for extraction method involving maximum likelihood estimate (the extraction method used here) is 100 to 200 for fairly complex models (Ding, Velicer, & Harlow, 1995; Hoelter, 1983). Thus the 223 teacher ratings and 223 parent ratings obtained in this study can be seen as appropriate for all the CFA conducted in this study. It is also to be noted that in the CFA MTMS analysis involving parcels, there are 26 free parameters. Thus this analysis is close to the more conservative 10 subjects to 1 free parameter guideline.

4 . 3 . 3 Measure

DSM-IV ADHD Rating Scale: The DSM-IV ADHD Rating Scale comprised all eighteen ADHD symptoms listed in DSM-IV. It has been used in a previous Australian study (Gomez et al., 1999). The scale lists the nine IA symptoms first followed by the nine H/I symptoms. Teachers and parents rated the occurrence of each symptom on a 4-point scale (i.e., 0 = “not at all”, 1 = “just a little”, 2 = “pretty much”, or 3 = “very much”). Gomez et al. (1999) provide information on the psychometric properties of the teacher and parent versions of the scale.

The findings of their study showed high internal consistencies for both teacher and parent ratings of both the IA and H/I subscales of the DSM-IV ADHD Rating Scale. The three-month interval test-retest reliability coefficients ranged from moderate to high, with teacher ratings showing higher test-retest reliability coefficients, and such results are consistent with existing data (Atkins, Pelham, & Licht, 1985; Schachar, Sandberg, & Rutter, 1986), and implies that teacher ratings may be more reliable than parent ratings for reporting ADHD symptoms. In terms of validity, there was support for the two-factor model that implies good construct validity of the DSM-IV ADHD Rating Scale. In addition, the high correlation coefficients between teacher and parent ratings of the IA and H/I subscales with the Conners Rating Scales suggested good concurrent validity of the ADHD Rating Scale.

Although the diagnostic interview asked the parents to consider their children's behaviour when not taking medication in order to confirm the ADHD diagnosis prior to the study, here the parents and teachers were instructed to complete the DSM-IV ADHD Rating Scale without this consideration. Given that children stop and begin medication treatment and other forms of home and school treatment fairly regularly, it was considered best to have the parents and teachers rate current symptom occurrence without this consideration.

4 . 3 . 4 Procedure

Data was collected during August-November 1999. Parents of ADHD children were sent letters providing background of the study and consent forms. The consent forms sought permission to contact them for a clinical interview, and a school telephone number to contact their children's class-teachers. When consent was obtained, parents were interviewed with the ADHD section of Barkley's Clinical Interview Schedule (1998b) to confirm ADHD diagnosis. For the majority of cases, this was conducted through home-visits, but in some cases because of far distances involved telephone interviews were used. Based on these interviews, the class-teachers of all children meeting the diagnosis of ADHD, were contacted to gain their consent to participate in the study. When this was obtained, the parents were sent a copy of the DSM-IV ADHD Rating Scale to complete. This questionnaire was also sent to the class-teachers for their completion.

4 . 4 Results

4 . 4 . 1 Descriptive information

Tables 3.1 and 3.2 provide a breakdown of the 18 ADHD symptoms. Inspection of these tables shows that the mean scores for the ADHD items ranged from 0.78 ("runs/climbs") to 2.05 ("distracted") for teacher ratings, and from 1.17 ("runs/climbs") to 2.42 ("distracted") for parent ratings. The standard deviations for the ADHD items ranged from 0.80 ("careless"; "forgetful") to 1.27 ("interrrupts") for teacher ratings, and from 0.69 ("distracted") to 1.18 ("talks") for parent ratings.

Table 3.1

Descriptive Information on ADHD Symptoms for Teacher Ratings

Symptoms	Mean	SD	Skewness	Kurtosis
1. Careless	1.79	.80	-2.06	-.78
2. Attention	1.71	.83	-0.53	-2.52
3. Listens	1.46	.93	.49	-4.37
4. Instructions	1.81	.93	-2.00	-3.79
5. Disorganised	1.88	.93	-2.37	-3.77
6. Unmotivated	1.81	96	-1.79	-5.01

Table 3.1, continued

7. Loses	1.49	95	.12	-5.07
8. Distracted	2.05	82	-3.14	-1.07
9. Forgetful	1.46	80	-.86	-1.87
10. Fidgets	1.54	1.01	.51	-7.87
11. Seat	1.10	.94	.2.86	-2.99
12.Runs/Climbs	.78	.90	5.54	1.03
13. Quiet	1.04	1.04	3.64	-1.56
14. Motor	1.24	1.24	2.22	-7.86
15. Talks	1.24	.1.24	3.12	-4.08
16. Blurts	1.08	.1.08	3.14	-4.60
17. Wait	1.10	1.10	2.40	-2.85
18. Interrupts	1.27	1.27	.95	-3.20

Note: *SD* = Standard Deviation

Table 3.2

Descriptive Information on ADHD Symptoms for Parent Ratings

Symptoms	Mean	SD	Skewness	Kurtosis
1. Careless	1.92	.79	-2.16	-1.08
2. Attention	1.89	.72	-2.12	.45
3. Listens	1.87	.88	-1.88	-3.17
4. Instructions	2.26	.74	-3.47	-2.04

Table 3.2, continued

5. Disorganised	2.17	.82	-3.82	-0.92
6. Unmotivated	2.20	.85	-4.20	-1.15
7. Loses	1.79	.98	-1.26	-7.26
8. Distracted	2.42	.69	-5.03	1.08
9. Forgetful	1.86	.86	-1.22	-4.05
10. Fidgets	1.81	.92	-1.29	-4.86
11. Seat	1.39	.98	.77	-6.24
12.Runs/Climbs	1.17	1.07	2.80	-6.75
13. Quiet	1.32	.95	1.05	-5.18
14. Motor	1.51	1.15	-0.33	-27.76
15. Talks	1.60	1.18	-0.76	-11.93
16. Blurts	1.51	1.11	-0.17	-16.82
17. Wait	1.65	1.07	-1.07	-10.72
18. Interrupts	1.82	1.12	-2.26	-12.57

Note: *SD* = Standard Deviation

To date, no definitive cutoff points have been firmly established as to when scores are not normally distributed (Curran, West, & Finch, 1996). Curran et al. has provided thresholds for the categorisation of distributions as normal, nonnormal, and extremely nonnormal. Scores are considered to be moderately nonnormal if their skewness values range from 2.00 to 3.00, and kurtosis nonnormality values range from 7.00 to 21.00. Extreme nonnormality is defined by skewness values greater than 3.00, and kurtosis values greater than 21.00. For teachers, for the 18 ADHD symptoms, the skewness values ranged between -3.14 to 5.54, whereas parent skewness values ranged between -7.87 to -.78. Skewness values for parents ranged between -5.03 to 2.82 and kurtosis values ranged from -27.76 to 1.08. These values imply that the ratings from both teachers and parents across the 18 ADHD symptoms were non-normally distributed. More importantly the test of multivariate normality for continuous variables involving all these measures showed significant multivariate skewness. For teachers, the skewness values were, 54.07, $z = 14.91$, $p < .001$, and kurtosis values, 396.66, $z = 7.72$, $p < .001$, and for parents, skewness values were 54.13, $z = 14.95$, $p < .001$, and kurtosis values, 384.69, $z = 5.95$, $p < .001$ Thus the assumption of multivariate normality was violated. Given that there was no multivariate normality, all CFA analyses in this study used the maximum likelihood procedure with robust estimation (Byrne, 1998; West, Finch, & Curran, 1995).

Tables 4 provide prevalence statistics based on the four-tier rating system (ie., ranging from 0 = "not at all" to 3 = "very much") for each of the 18 ADHD symptoms for teacher and parent ratings. As can be seen, for the IA symptoms most ratings given by teachers and parents were 2 and 3. For H/I most ratings were 1, 2, and 3 with little difference between 1, 2, and 3.

Table 4.1

Prevalence Rates of the 18 ADHD Symptoms Based on Teacher Ratings

	Symptom Ratings			
Symptoms	Not at all	Just a little	Pretty much	Very much
1. Careless/Details	4.0	23.3	48.9	23.8
2. Attention	3.1	22.4	57.0	17.5
3. Listen	6.3	26.9	40.4	26.4
4. Instructions	4.0	15.2	40.8	40.0
5. Disorganised	3.1	17.0	39.9	40.0
6. Unmotivated	3.6	17.5	34.5	44.4
7. Loses	9.9	30.9	29.6	29.6
8. Distracted	0.9	8.5	38.6	52.0
9. Forgetful	4.9	30.1	39.0	26.0
10. Fidgets	7.6	30.5	35.4	26.5
11. Seat	21.1	34.1	29.6	15.2
12. Runs/climbs	33.2	32.7	17.5	16.6
13. Quiet	22.4	35.4	30.0	12.2
14. Motor	27.4	20.2	26.9	25.5
15. Talks	20.2	25.5	28.7	25.6
16. Blurts	24.7	24.2	26.9	24.2
17. Wait	18.4	25.6	29.1	26.9
18. Interrupts	17.0	22.0	23.3	37.7

Table 4.2

Prevalence Rates of the 18 ADHD Symptoms Based on Parent Ratings

	Symptom Ratings			
Symptoms	Not at all	Just a little	Pretty much	Very much
1. Careless/Details	6.3	26.0	50.2	17.5
2. Attention	6.3	34.1	42.2	17.4
3. Listen	15.7	37.2	32.3	14.8
4. Instructions	9.4	26.0	38.6	26.0
5. Disorganised	8.5	24.7	37.2	29.6
6. Unmotivated	9.9	27.4	35.0	27.7
7. Loses	16.1	34.5	33.2	16.2
8. Distracted	4.0	19.3	44.4	32.3
9. Forgetful	12.1	37.2	43.0	7.7
10. Fidgets	15.7	36.8	25.1	22.4
11. Seat	30.0	39.0	21.5	9.5
12. Runs/climbs	47.1	35.4	10.3	7.2
13. Quiet	31.8	41.7	17.1	9.4
14. Motor	30.0	32.7	20.2	17.1
15. Talks	24.7	39.9	22.2	13.2
16. Blurts	31.9	31.3	25.2	11.6
17. Wait	30.5	39.5	19.2	10.8
18. Interrupts	21.1	43.9	21.5	13.5

4 . 5 Preliminary results

Prior to the CFA analyses, the correlations among the symptoms were examined. Also, the teacher and parent ratings of the ADHD symptoms were subjected to EFA. These results will be presented in the following section.

4 . 5 . 1 Intercorrelations between symptoms

Tables 5.1 and 5.2 show the Pearson's correlations of the 18 items for teacher and parent ratings, respectively. In general, the intercorrelations among the H/I symptoms were much higher than the intercorrelations among the IA symptoms for both teacher and parent ratings. Taken overall, for teacher and parent ratings, the intercorrelations among the IMP symptoms were stronger than the correlations between the HYP or IA symptoms.

Table 5.1

Correlation Coefficients for Teacher Ratings of ADHD Symptoms

Symptoms		T1	T2	T3	T4	T5	T6	T7	T8	T9
Careless/Details	(T1)	1.00								
Attention	(T2)	.67	1.00							
Listen	(T3)	.49	.44	1.00						
Instructions	(T4)	.64	.73	.48	1.00					
Disorganised	T5)	.56	.63	.35	.64	1.00				
Unmotivated	(T6)	.69	.66	.38	.65	.63	1.00			
Loses	(T7)	.43	.35	.28	.47	.43	.51	1.00		
Distracted	(T8)	.64	.62	.43	.56	.58	.65	.39	1.00	
Forgetful	(T9)	.50	.47	.47	.51	.48	.46	.46	.42	1.00

Table 5.1, continued

Fidgets	(T10)	.40	.45	.38	.32	.28	.27	.27	.41	.32
Seat	(T11)	.39	.38	.27	.27	.20	.32	.32	.37	.16
Runs/climbs	(T12)	.21	.18	.31	.14	.14	.13	.14	.29	.07
Quiet	(T13)	.25	.30	.26	.15	.15	.23	.15	.40	.07
Motor	(T14)	.27	.27	.38	.21	.19	.11	.16	.32	.11
Talks	(T15)	.24	.25	.25	.20	.15	.23	.23	.33	.09
Blurts	(T16)	.15	.21	.19	.12	.08	.13	.11	.32	.08
Wait	(T17)	.14	.25	.23	.14	.07	.08	.11	.32	.12
Interrupts	(T18)	.10	.21	.20	.11	.04	.09	.10	.31	.06

Symptoms		T10	T11	T12	T13	T14	T15	T16	T17	T18
Careless/Details	(T1)									
Attention	(T2)									
Listen	(T3)									
Instructions	(T4)									
Disorganised	(T5)									
Unmotivated	(T6)									
Loses	(T7)									
Distracted	(T8)									
Forgetful	(T9)									
Fidgets	(T10)	1.00								
Seat	(T11)	.62	1.00							
Runs/climbs	(T12)	.48	.55	1.00						
Quiet	(T13)	.51	.58	.52	1.00					
Motor	(T14)	.59	.55	.63	.65	1.00				

Table 5.1, continued

Talks	(T15)	.52	.59	.50	.58	.58	1.00			
Blurts	(T16)	.56	.58	.56	.58	.60	.61	1.00		
Wait	(T17)	.53	.53	.53	.60	.62	.69	.76	1.00	
Interrupts	(T18)	.50	.60	.52	.64	.56	.75	.78	.91	1.00

Table 5.2

Correlation Coefficients for Parent Ratings of ADHD Symptoms

Symptoms		P1	P2	P3	P4	P5	P6	P7	P8	P9
Careless/Details	(P1)	1.00								
Attention	(P2)	.47	1.00							
Listen	(P3)	.34	.32	1.00						
Instructions	(P4)	.43	.39	.39	1.00					
Disorganised	(P5)	.41	.44	.43	.53	1.00				
Unmotivated	(P6)	.57	.32	.37	.55	.53	1.00			
Loses	(P7)	.34	.33	.37	.35	.45	.44	1.00		
Distracted	(P8)	.22	.39	.31	.27	.35	.40	.30	1.00	
Forgetful	(P9)	.33	.50	.20	.39	.34	.35	.42	.23	1.00
Fidgets	(P10)	.15	.32	.29	.19	.24	.16	.29	.26	.36
Seat	(P11)	.21	.26	.31	.17	.19	.16	.29	.21	.20
Runs/climbs	(P12)	.02	.09	.20	.17	.03	.04	.10	.11	.12
Quiet	(P13)	.26	.31	.35	.19	.17	.14	.38	.17	29
Motor	(P14)	.10	.13	.23	.18	.06	.04	.13	.18	.04
Talks	(P15)	.20	.05	.22	.04	.00	.10	.16	.26	.05

Table 5.2, continued

Blurts	(P16)	.19	.06	.19	.15	.11	.19	.11	.14	.12
Wait	(P17)	.32	.10	.20	.17	.12	.02	.07	.21	.07
Interrupts	(P18)	-.08	.02	.25	.12	.03	.04	.13	.16	.01

Symptoms		P10	P11	P12	P13	P14	P15	P16	P17	P18
Careless/Details	(P1)									
Attention	(P2)									
Listen	(P3)									
Instructions	(P4)									
Disorganised	(P5)									
Unmotivated	(P6)									
Loses	(P7)									
Distracted	(P8)									
Forgetful	(P9)									
Fidgets	(P10)	1.00								
Seat	(P11)	.38	1.00							
Runs/climbs	(P12)	.41	.44	1.00						
Quiet	(P13)	.33	.44	.44	1.00					
Motor	(P14)	.41	.41	.59	.48	1.00				
Talks	(P15)	.29	.30	.35	.37	.48	1.00			
Blurts	(P16)	.22	.26	.28	.28	.27	.48	1.00		
Wait	(P17)	.34	.29	.44	.37	.51	.45	.54	1.00	
Interrupts	(P18)	.22	.25	.41	.35	.43	.53	.59	.69	1.00

4 . 5 . 2 Exploratory factor analysis

Principal Component Analysis with oblique (oblimin) rotation was used to examine the structure of the 18 ADHD symptoms. The analyses were performed separately on the teacher and parent ratings. These analyses permitted a comparison of the factor structure of the ADHD symptoms in samples of children observed in different settings by different raters, as is specified in the cross-situational impairment criterion in the DSM-IV guidelines. Components with eigenvalues greater than one were retained with the resultant factor structure including communalities and loadings (after rotation) displayed in Tables 6.1 and 6.2.

Two factors accounted for 61.6% of the variance in the teacher ratings. For the two factors extracted, the H/I factor accounted for substantially more of the variance (45.3%) than the IA factor (16.3%). The first factor, the H/I factor comprised all the 9 H/I items, and the second factor, the IA factor comprised all 9 IA items.

For parents, three factors accounted for 59.7% of the variance. The first factor comprised all the H/I items, and this factor accounted for 33.1% of the variance. The second factor comprised all the IA items, and accounted for 20.6% of the variance. The third factor comprised the IMP items and one HYP item (item 15, "talks excessively"), and this factor accounted for 6% of the variance.

It should also be noted that, based on the guideline suggested by Hair, Anderson, Tatham, and Black (1999), that communality values less than .50 are of insufficient statistical power. Assessment of the symptoms revealed two teacher items ("listens"; "fidgets") and two parent items ("unmotivated"; "distracted") with values less than .50. However, given that the purpose of the exploratory analysis was essentially to establish an hypothetical structure for the ADHD symptoms, these items have still been retained in the analysis, but the variables in question could be regarded as somewhat poorly represented in this factor solution.

4 . 5 . 2 . 1 Factor loadings for teachers and parent ratings

Based on the relatively conservative formula provided by Hair et al. (1999) sample sizes greater than 200 require factor loadings ≥ .40 for the values to be considered significant.

Given this, for teacher ratings, as shown by Table 6.1, for the two-factor IA and H/I structure all symptoms had significant factor loadings, and there were no cross-loadings. The H/I factor loadings ranged from .51 ("fidgets") to .86 ("motor"), and the IA factor loadings ranged from .50 ("listen") to .88 ("disorganised"). The average of the factor loadings for the IA dimension was quite substantial at .75, and for the H/I dimension it was slightly higher at .77. Taken together, for teacher ratings a simple structure solution was obtained with a single high loading for each variable on only one factor.

Table 6.2 shows that for parents, there was greater symptom variability, the factor loadings for parents ratings were consistently lower than those for teacher ratings, and the three-factor structure had a closer approximation with the former DSM-III model. For the three-factor IA, HYP, and IMP structure, all symptoms had significant factor loadings and these ranged from .44 to .81. For the first factor, the HYP factor loadings ranged between .44 ("talks") to .81 ("runs/climbs"; "quiet"). For the second factor, the IA loadings ranged from .44 ("listens") to .79 ("disorganised"). The third factor, the IMP factor comprised the three IMP items ("blurts", "waits", "interrupts"), together with the HYP item 15 ("talks excessively"). The average of the factor loadings for the IA dimension was .67, for the HYP dimension .70, and for the IMP dimension .63. Within the three factors identified, two items had crossloadings. The IA item (item 3, "listen"), and the HYP item (item 15, "talks") had crossloadings on the IMP factor.

Table 6.1

Rotated Factor Loadings and Communalities of ADHD Symptoms for Teacher Ratings

Symptoms	Factor 1	Factor 2	*h*
1. Careless/Details	.08	.75	.56
2 Attention	.00*	.81	.64
3. Listen	.29	.50	.46
4. Instructions	.00*	.85	.69
5. Disorganised	.17	.88	.68
6. Unmotivated	.00*	.79	.62
7. Loses	.00*	.72	.55
8. Distracted	.13	.73	.62
9. Forgetful	.00	.74	.56
10. Fidgets	.51	.29	.47
11. Seat	.68	.22	.64
12. Runs/climbs	.79	.00*	.65
13. Quiet	.71	.00	.56
14. Motor	.86	.00*	.68

15. Talks	.80	.00*	.60
16. Blurts	.85	.11	.66
17. Wait	.85	.00*	.73
18. Interrupts	.84	.00*	.70

Note: Loadings of ≥ .40 are underlined, *h* = communality; All values significant at $p < .05$ unless non significant as indicated *.

Table 6.2

Rotated Factor Loadings and Communalities of ADHD Symptoms for Parent Ratings

Symptoms	Factor 1	Factor 2	Factor 3	h
1. Careless/Details	.15	.68	.30	.54
2 Attention	.20	.70	.20	.56
3. Listen	.00	.44	.60	.54
4. Instructions	.00	.78	.00	.61
5. Disorganised	-.11	.79	.00*	.60
6. Unmotivated	.00*	.68	.00*	.47
7. Loses	.00*	.71	.10	.51
8. Distracted	.00*	.55	.11	.35
9. Forgetful	-.11	.71	.24	.55
10. Fidgets	.65	.26	.00*	.52
11. Seat	.74	.00*	.00*	.55
12. Runs/climbs	.81	.00*	.11	.72
13. Quiet	.81	.00*	.00*	.69

Table 6.2, continued

14. Motor	<u>.74</u>	.12	.20	.69
15. Talks	<u>.44</u>	.00*	<u>.44</u>	.54
16. Blurts	.30	.00*	<u>.68</u>	.70
17. Wait	.36	.00*	<u>.69</u>	.79
18. Interrupts	.34	.00*	<u>.72</u>	.81

<u>Note</u>: Loadings of ≥ .40 are underlined, h = communality; All values significant at $p < .05$ unless non significant as indicated *.

With regard to the overall factor correlations, Table 7, shows that in the two-factor model (ie., IA and H/I), teacher ratings produced a moderate correlation between factors that was about double that of parent ratings.

Table 7

Correlations between the Factors in the Two Factor Model of Teacher and Parent Ratings using Exploratory Factor Analysis

Correlations between factors	
<u>Teacher ratings</u>	<u>Parent ratings</u>
.50	.24

<u>Note:</u> All correlations significant at $p < .05$.

Parent ratings for the three-factor model (ie., HYP as factor 1, IA as factor 2, and IMP as factor 3) produced low correlations between IA and HYP, and IA and IMP, respectively (see Table 8).

Table 8

Correlations Between the Factors in the Three Factor Model of Parent Ratings Using Exploratory Factor Analysis

	Correlations between Factor 1, Factor 2, and Factor 3	
	Parent Ratings	
	Factor 1	Factor 3
Factor 2	.26	.18
Factor 1	-	.71

Note: All correlations significant at $p < .01$.

There was a strong correlation between HYP and IMP, and it is suggested that the high correlation between the HYP and IMP factors found in this study and past studies is indicative that these two factors are very closely related. Taken together, the results of the EFA suggest that the current DSM-IV system represent an appropriate organisational structure for the ADHD symptoms.

4.6 Structural organisation of the DSM-IV ADHD symptoms: Testing for one, two and three factor models based on a single source

For all models tested, the covariance matrix of the ratings on all eighteen items of the DSM-IV ADHD Rating Scale was subjected to confirmatory factor analysis (CFA) using LISREL 8.51 (Joreskog & Sorbom, 2001). Joreskog and

Sorbom (1996) have suggested that when LISREL is used to analyse all variables that are ordinal (as in this study) the polychoric matrix be analysed, using weighted least square estimation procedure. However, they have also pointed out that when the sample is not sufficiently large, it is better to use the covariance matrix with the maximum likelihood method. Given this, and the lack of multivariate normality, robust estimation using maximum likelihood was used. Measures of absolute fit, comparative fit, and parsimonious fit were used to evaluate the fit of each model.

4.6.1 Tests of absolute fit

Tests of absolute fit compare the model under consideration with a model that provides a perfect fit to the data. Absolute fit concerns "the degree to which the covariances implied by the fixed and free parameters specified in the model match the observed covariances from which free parameters in the model are estimated" (Hoyle & Panter, 1995, p. 165). Thus the ability of the postulated model to reproduce the covariance matrix is determined. Statistical fit was evaluated with the Satorra-Bentler scaled chi-square statistic (S-Bχ^2) since this measure corrects for multivariate non-normality. Also as recommended by West et al. (1995), the alpha level for the significance tests of the factor loadings and factor correlations in CFA procedures was reduced from .05 to .001 to decrease the likelihood of concluding significance values incorrectly. A further reason for this reduction was to allow comparability of findings with previous studies (Gomez et al., 2003) that also used $p < .001$ to infer significance. Finally, as difference between two S-Bχ^2 values is not distributed as a chi-square, it is necessary to adjust for this difference. The formula for this adjustment is available in Satorra and Bentler (1999; see also Muthen & Muthen, 1998).

As χ^2 values, including S-Bχ^2 values are affected substantially by sample size, almost any model will be rejected when the sample size is greater than 200 (Kelloway, 1998), as in this study. Thus indices of fit less affected by sample size were also computed including the standardised root mean square residual (RMSR), the root mean square error of approximation (RSMEA) and its 90% confidence interval, and the goodness of fit index (GFI). The GFI provides a measure of the relative amount of variance and covariance jointly accounted for by the model, and values range from 0 to 1, with higher values indicating a better fit. Generally, values of more than 0.80 are accepted as sufficient fit with values greater than 0.90 a good fit. However, Kelloway (1998) has commented that, as this index has no known sampling distribution, that rules about goodness of fit are highly arbitrary and must be treated with caution.

The RMSR and RMSEA are measures of how well the model reproduces the covariance matrix. The RMSR is the square root of the mean of the squared residuals, i.e., an average of the residuals between observed and estimated input matrices. Similar to the RMSR, the RMSEA is based on the analysis of residuals. For the RMSR a lower value indicates a better fit. Values of less than 0.10 are considered as acceptable fit, with value of 0.05 or less considered a good fit (Hair et al., 1999; Kelloway, 1998). The RMSEA is regarded by Kelloway (1998) as one of the most informative indices because, taking into account the error of approximation in the population, it is index sensitive to the number of estimated parameters in the model (i.e., the complexity of the model). For RMSEA, its developer Steiger (1990) has suggested that values below 0.10 indicate a good fit to the data, and values below 0.05 a very good fit to the data. Alternatively, others have considered values between 0.05-0.08 to be a reasonable fit (Browne & Cudeck, 1993), or acceptable/marginal fit (Hair et al., 1999; Kelloway, 1998). MacCallum, Browne, and Sugawara (1996) have regarded values between 0.08-0.10 as a mediocre fit, and values above 0.10 as a poor fit. The RMSEA provides a 90% confidence interval for the point estimate.

4.6.2 Tests of comparative fit

Comparative or incremental fit concerns the degree to which the model in question is superior to an alternative model, usually one that specifies no covariances among variables (i.e., the "null" or independence model) in reproducing the observed covariances (Hoyle & Panter, 1995). To assess comparative or incremental fit, the Non-Normed Fit Index (NNFI) or Tucker Lewis Index (TLI), the Comparative Fit Index (CFI), and Expected Cross-Validation Index (ECVI), were computed. The NNFI adjusts for the number of degrees of freedom in the model and indicates the percentage of improvement in fit over the model with no free paths. An NNFI of .85, for instance indicates that the hypothesised model is 85% better fitting than the model with no free paths (Kelloway, 1998). The CFI is based on the noncentral χ^2 distribution (Bentler, 1995) that can be estimated as $\chi^2 - df$. For the NNFI (or TLI), and CFI, values range from 0 to 1.0, with values exceeding 0.90 indicating a good fit. The ECVI is an approximation of the goodness of fit of the estimated model to another sample of the same size (Kelloway, 1998) The ECVI has a lower bound of 0, although no upper bound. There is no specified range of acceptable values but smaller values indicate a better fit.

4 . 6 . 3 Tests of parsimonious fit

Tests of parsimonious fit evaluate the parsimony of the model under consideration by adjusting other indices of fit for model complexity. To assess parsimonious fit the Parsimony Normed Fit Index (PNFI) was computed. This measure is used to compare different models and takes into account the number of *df* used to achieve a level of fit. The values range between 0 and 1.0. Hair et al. (1999) suggest that higher values indicate greater model parsimony, and when comparing models differences of 0.06 to 0.09 are indicative of substantial model differences. Kelloway (1998) has suggested that there is no standard of how "high" the index should be to indicate parsimonious fit, and it is unlikely that the PNFI will reach the 0.90 cutoff used for other fit indices. Mulaik, James, and Van Alstine (1989) have suggested that, it is not uncommon for goodness-of-fit indices in the 0.90's to be accompanied by PNFI values in the 0.50's.

4 . 7 Confirmatory factor analysis for models of teacher and parent ratings of ADHD symptoms.

The results of the CFA for teacher ratings are reported in Table 9. Estimation was by the method of maximum likelihood. As will be noticed, in all analyses, the S-Bχ^2 values were significant, implying that all models fitted the ratings poorly. However as already noted, the χ^2 values, including S-Bχ^2 values are not suitable indices of fit for large samples.

For teacher ratings, in relation to other indices of fit, an examination of Table 8 shows that in all cases the RMSR, RMSEA, and ECVI values were lower, and the CFI, GFI, NNFI and PNFI values were higher for the two and three-factor models compared to the one-factor model.

Table 9.

Fit Indices for the One Factor, Two Factor, and Three Factor CFA Models for Teacher Ratings of the DSM IV ADHD Rating Scale

Model	df	χ^2	S-Bχ^2	CFI	GFI	NNFI	ECVI	RMSR	RMSEA	PNFI
One factor	135	1023.36	1753.40	.87	.49	.85	8.22	.14	0.23 (.22-.24)	.75
Two factor	134	399.99	371.04	.96	.82	.95	2.01	.078	0.089 (.08-.10)	.82
Three factor	132	336.23	287.14	.97	.86	.96	1.64	.072	0.08 (.07-.09)	.82

Note: χ^2 = minimum fit χ^2; S-Bχ^2 = Satorra-Bentler χ^2; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation (values in brackets = 90% confidence interval); PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, RMSR, RMSEA and ECVI, and higher values for CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 values were significant at $p < .001$.

Table 10 provides a comparison of fit measures of the one, two, and three-factor models for teachers, using the different indices. This has been done by comparing the differences between models 1 and 2, models 1 and 3, and models 2 and 3. As previously noted, to test whether the postulated model provided a better fit than an alternative model, it was proposed to use a chi-square difference testing procedure with the Satorra-Bentler scaled chi-square. As the S-Bχ^2 value was unexpectedly higher than χ^2 minimum fit value, negative values were obtained for the ΔS-Bχ^2 test. Given that negative χ^2 values are not possible the interpretation was based on the minimum fit χ^2.

Table 10

Comparison of One, Two, and Three Factor CFA Models for Teacher Ratings using Differential Goodness-of-Fit Indices

Model	Δdf	Δχ^2	ΔCFI	ΔGFI	ΔNNFI	ΔECVI	ΔRMSR	ΔRMSEA	ΔPNFI
1F v. 2F	1	623.97	.09	.33	.10	6.21	.062	.14	.07
1F v. 3F	3	687.13	.10	.37	.11	6.58	.068	.14	.07
2F v. 3F	2	63.76	.01	.04	.01	0.37	.006	.01	.00

Note: χ^2 = minimum fit χ^2; S-Bχ^2 = Satorra-Bentler χ^2; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation; PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, RMSR, RMSEA and ECVI, and higher values for CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 and S-Bχ^2 values were significant at $p < .001$, unless otherwise indicated, ^{ns} = non significant. * As the S-Bχ^2 was higher than the minimum fit χ^2 the S-Bχ^2 showed a negative value. As -χ^2 values are not possible no scores are shown. Given this the interpretation was based on minimum fit χ^2.

Table 10, showing the χ^2 difference values for teacher ratings, indicated that there were significant differences between the two and three-factor models ($\Delta\chi^2_{(2)} = 63.76, p < .001$)), but there were only minimal differences in practical fit for most indices between the two and three-factor model (ΔCFI = .01; ΔGFI = .04; ΔNNFI = .01; ΔECVI = .37; ΔPNFI = .00). The χ^2 difference values for the comparisons of the two and three-factor models were low compared to the comparisons of the one-factor model with the two and three-factor models.

The results of the CFA for parent ratings are reported in Table 11. As will be noticed, in all analyses, the S-Bχ^2 values were significant, implying that all models fitted the ratings poorly. However as already noted, the S-Bχ^2 value is not a suitable index of fit for large samples, such as applies in this study.

As shown by Table 11, for the two and three-factor models, the, RMSR, RMSEA, and ECVI values were lower, and the CFI, GFI, NNFI and PNFI values were higher for the two and three-factor models compared to the one-factor model.

Table 11

Fit Indices for the One Factor, Two Factor and Three Factor CFA models for Parent Ratings of the DSM IV ADHD Rating Scale

Model	df	χ^2	S-Bχ^2	CFI	GFI	NNFI	ECVI	RMSR	RMSEA	PNFI
One factor	135	1042.20	1531.44	.77	.53	.74	7.22	.18	0.22 (.21-.23)	.66
Two factor	134	493.41	462.65	.91	.79	.90	2.42	.096	0.11 (.10.12)	.77
Three factor	132	349.18	283.01	.94	.86	94	1.63	.091	0.07 (.06-.08)	.79

Note: χ^2 = minimum fit χ^2; S-B = Satorra-Bentler χ^2; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation (values in brackets = 90% confidence interval); PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, RMSR, RMSEA and ECVI, and higher values for CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 values were significant at $p < .001$

Table 12 provides a comparison of fit measures of the one, two, and three-factor models for parents, using the different indices. This has been done by comparing the differences between models 1 and 2, models 1 and 3, and models 2 and 3.

For parent ratings, similar to the results for teacher ratings a minimum fit $\Delta\chi^2$ test was used, and the χ^2 difference values shown in Table 12 indicated that there were significant differences between the two and three-factor models ($\Delta\chi^2_{(2)} = 144.23, p < .001$), but there were only minimal differences in practical fit for most indices between the two and three-factor model (ΔCFI = .03; ΔGFI = .07; ΔNNFI = .04; ΔECVI = .79; ΔPNFI = .02). The χ^2 difference values for the comparisons of the two and three-factor models were low compared to the comparisons of the one-factor model with the three-factor model.

Table 12

Comparison of One, Two, and Three Factor CFA Models for Parent Ratings using Differential Goodness-of-Fit Indices

Model	Δdf	$\Delta\chi^2$	ΔCFI	ΔGFI	ΔNNFI	ΔECVI	ΔRMSR	ΔRMSEA	ΔPNFI
1F v. 2F	1	548.79	.14	.26	.16	4.80	.084	.11	.11
1F v. 3F	3	693.02	.17	.33	.20	5.59	.089	.15	.13
2F v. 3F	2	144.23	.03	.07	.04	0.79	.005	.04	.02

Note: χ^2 = minimum fit χ^2; S-Bχ^2 = Satorra-Bentler χ^2; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation; PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, RMSR, RMSEA and ECVI, and higher values for CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 and S-Bχ^2 values were significant at $p < .001$, unless otherwise indicated, * As the S-Bχ^2 was higher than the minimum fit χ^2 the S-Bχ^2 showed a negative value. As -χ^2 values are not possible no scores are shown. Given this the interpretation was based on minimum fit χ^2.

Taken together, in terms of examining the different indices, for both teacher and parent ratings, the absolute fit indices (GFI, RMSR, and RMSEA), comparative or incremental fit indices (CFI, NNFI, and ECVI), and parsimonious fit index (PNFI), showed a substantial improvement in fit for the two-factor model over the one-factor model, and the three-factor model over the one-factor model. Although the RMSR, RMSEA, and ECVI values were lower, and the CFI, GFI, NNFI, and PNFI values were higher for the three-factor model compared to the two-factor model, the differences between these models for these indices were lower compared to the differences for these indices between the one-factor, and two and three-factor models, respectively. Thus there were only very minimal differences between all goodness-of-fit indices for the two-factor and three-factor models.

Table 13 shows the correlation coefficients between the factors in the two-factor model, and in the three-factor model.

Table 13

Correlations between the Factors in the Two and Three Factor Models of Teacher and Parent Ratings using Confirmatory Factor Analysis

2 Factor Model: Correlations between Inattention and Hyperactivity-Impulsivity

Teacher ratings	Parent ratings
.51	.19

3 Factor Model: Correlations between Inattention, Hyperactivity & Impulsivity

	Teacher ratings		Parent ratings	
	Hyperactivity	Impulsivity	Hyperactivity	Impulsivity
Inattention	.53	.44	.22	.14*
Hyperactivity	--	.86	--	.76

Note: All correlations significant at $p < .01$, unless non-significant as indicated *.

These correlation coefficients were computed to examine how the different ADHD symptom dimensions were related. As will be noted in the two-factor model, there was a moderate correlation between the IA and H/I dimensions for teacher ratings, but for parent ratings there was only a small correlation between IA and H/I. These findings, particularly the parent ratings, provide support for the relative independence of IA from H/I.

Consistent with past findings of three-factor models of the ADHD symptoms, both teacher and parent ratings showed a higher correlation between HYP and IMP, than between IA and HYP, or IA and IMP. In particular, for parent ratings, the high correlation between HYP and IMP, the non-significant correlation between IA and IMP, and the low correlation between IA and HYP, suggested greater support for a two-factor structure than a three-factor structure. Indeed, confirmation of the relative merits of the two-factor model over the three-factor model was provided by the Fisher *r* to *z* transformation test. For both teacher and parent ratings the correlation coefficients of HYP and IMP were significantly higher ($p < .001$) than that of IA and HYP, and IA and IMP. Thus overall the association between the HYP and IMP symptoms was much stronger than the association between IA and HYP, and IA and IMP.

In addition, to further establish the usefulness of the IA and H/I latent constructs, using the loadings shown in Tables 14.1 and 14.2, composite reliability and variance extracted tests were used to assess the psychometric properties of the two-factor model.

The composite reliability test assesses the internal consistency of a construct and is analogous to coefficient alpha. Based on the formula provided by Hair et al. (1999) a latent construct is considered to have acceptable composite reliability if the reliability of the construct exceeds .70. The composite reliability method produced acceptable reliability for both teacher and parent ratings. For both teachers and parents, the composite reliability was .90 for the IA factor, and .90 for the H/I factor.

Table 14.1

Completely Standardised Loadings from Confirmatory Factor Analysis of ADHD Symptoms for Teacher Ratings

	Two Factor Solution	
Symptoms	IA	H/I
1. Careless/Details	.71	.00
2 Attention	.76	.00
3. Listen	.62	.00
4. Instructions	.81	.00
5. Disorganised	.76	.00
6. Unmotivated	.76	.00
7. Loses	.72	.00
8. Distracted	. 75	.00
9. Forgetful	.71	.00
10. Fidgets	.00	.61
11. Seat	.00	.75
12. Runs/climbs	.00	.78
13. Quiet	.00	.71
14. Motor	.00	.78
15. Talks	.00	.73
16. Blurts	.00	.78
17. Wait	.00	.85
18. Interrupts	.00	.85

Note: All loadings were significant at $p < .001$; IA = inattention; H/I = hyperactivity-impulsivity

Table 14.2

Completely Standardised loadings from Confirmatory Factor Analysis of ADHD Symptoms for Parent Ratings

	Two Factor Solution	
Symptoms	IA	H/I
1. Careless/Details	.61	.00
2 Attention	.65	.00
3. Listen	.44	.00
4. Instructions	.76	.00
5. Disorganised	.72	.00
6. Unmotivated	.64	.00
7. Loses	.66	.00
8. Distracted	.53	.00
9. Forgetful	.66	.00
10. Fidgets	.00	.52
11. Seat	.00	.57
12. Runs/climbs	.00	.74
13. Quiet	.00	.70
14. Motor	.00	.70
15. Talks	.00	.69
16. Blurts	.00	. 76
17. Wait	.00	.85
18. Interrupts	.00	.85

Note: All loadings were significant at $p < .001$; IA = inattention; H/I = hyperactivity-impulsivity

The variance extracted method measures the amount of variance captured by a construct in relation to the variance due to random measurement error. Based on the formula provided by Hair et al. (1999) the indicator reliability should exceed .50. The variance extracted method provided data that was above the recommended level of .50 except for the parent IA factor. For teachers, for the variance extraction method, reliability was .54 for the IA factor and .57 for the H/I factor. For parents it was .41 for the IA factor and .52 for the H/I factor. Together, these results provided support for the internal consistency of the IA and H/I constructs.

Taken overall, use of standard CFA procedures showed that the three- and two-factor models fitted the data better than the one-factor model, and the two-factor model provided a better fit to the data than the three-factor model. In turn, reliability testing of the two-factor model demonstrated good internal consistency for the IA and H/I factors. These results thus suggested that the DSM-IV two-factor model is an appropriate model for the ADHD symptoms.

4.8 Trait, source, and error variance in the ADHD symptoms: Examining construct validity using CFA multitrait-multisource analysis

As already pointed out, and as utilised in previous studies (Burns et al., 2003; Gomez et al., 2003), the procedures described by Byrne (1998) were chosen to evaluate the construct validity (both convergent and discriminant validity) of the ADHD-IA and H/I symptoms, and the amount of trait, source, and error variance in the ADHD symptoms.

The CFA MTMS symptom parcel analysis reported here has been organised as follows. The matrix level will be reported first followed by the parcel level.

Because the evaluation at the parcel level can result in the qualification of positive results at the matrix level, the parcel level may be regarded as more important for the evaluation of the convergent and discriminant validity of the ADHD symptoms.

4 . 8 . 1 Testing for convergent and discriminant validity at the parcel level

As previously discussed, ADHD symptom parcels were used in this analysis in preference to individual symptoms. Details of the symptom parcels were outlined in an earlier part of this chapter. Prior to the CFA MTMS analysis the descriptive scores for the ADHD symptom parcels are presented.

4 . 8 . 1 . 1 Descriptive information

Descriptive data for the DSM-IV ADHD symptom parcels were computed using PRELIS 2.53. Tables 15.1 and 15.2 show descriptive information of the ADHD symptom parcels for teacher and parent ratings, respectively. Following the previously discussed guidelines of Curran et al. (1996) scores with skewness values > 3.0, and kurtosis values >21 were considered extremely non-normal.

For teacher ratings, inspection of Table 14.1 revealed that the skewness values ranged between -3.78 (IA parcel 1) to 0.70 (H/I parcel 2), and kurtosis values ranged between -6.56 (H/I parcel 1) to 0.84 (IA parcel 2). These values imply that the ratings of teachers for the symptom parcels were nonnormally distributed.

Table 15.1

Descriptive Information on Teacher Ratings of the ADHD Symptom Parcels

	Mean	*SD*	Skewness	Kurtosis
IA Parcel 1	8.76	2.25	-3.78	0.47
IA Parcel 2	9.61	3.09	-1.64	0.84
Mean IA Parcels	9.19	2.67	-2.71	0.66
H/I Parcel 1	7.81	4.22	0.63	-6.56
H/I Parcel 2	5.95	3.18	0.70	0.47
Mean H/I Parcels	6.88	3.70	0.67	-3.52

Note: *SD* = standard deviation; IA = inattention; H/I = hyperactivity-impulsivity

More importantly, the test of multivariate normality for continuous variables involving all these measures showed significant multivariate skewness and kurtosis. For teachers, skewness values were 1.15, $z = 2.84$, $p < .005$, and kurtosis values 21.64, $z = 2.78$, $p < .006$. Thus the assumption of multivariate normality was violated, and, therefore as previously noted, all CFA analyses in this study used maximum likelihood procedures with robust estimation (Byrne, 1998, West et al., 1995).

For parent ratings, inspection of Table 15.2 revealed that the skewness values ranged between –2.36 (IA parcel 1) to 3.45 (H/I parcel 2), and kurtosis values ranged between –2.80 (H/I parcel 1) to –1.24 (IA parcel 1). These values imply that the ratings of parents for the symptom parcels were nonnormally distributed.

Table 15.2

Descriptive Information on Parent Ratings of the ADHD Symptom Parcels

	Mean	*SD*	Skewness	Kurtosis
IA Parcel 1	7.38	2.93	-2.36	-1.66
IA Parcel 2	8.09	3.37	-1.96	-1.24
Mean IA Parcels	7.74	3.15	-2.16	-1.45
H/I Parcel 1	5.91	3.94	2.71	-2.80
H/I Parcel 2	4.48	3.09	3.45	-1.26
Mean H/I Parcels	5.20	3.52	3.08	-2.03

Note: *SD* = standard deviation; IA = inattention; H/I = hyperactivity-impulsivity

More importantly, the test of multivariate normality for continuous variables involving all these measures showed significant multivariate skewness, but not for kurtosis. For parents, skewness values were 1.60, $z = 4.25$, $p < .0001$, and kurtosis values 25.21, $z = 1.46$, $p < .14$. Thus the assumption of multivariate normality was violated for skewness values, but not for kurtosis values. Given these results, all CFA analyses used the maximum likelihood procedure with robust estimation (Byrne, 1998; West et al., 1995).

4 . 9 CFA parcel analyses of two-factor model of teacher and parent ratings of ADHD symptoms

As previously shown, a two-factor CFA model of the total ADHD symptoms in alignment with DSM-IV diagnostic criteria is an appropriate symptom organisation. Prior to CFA MTMS analyses, standard parcel CFA analyses was executed to ascertain whether this procedure would result in an improved goodness of fit over the total symptom procedure. As previously noted, parcelling the ADHD symptoms is more in keeping with the way the symptoms are organised in DSM-IV, and for both teacher and parent ratings the parcel CFA analyses provided a substantial improvement in goodness of fit.

For teacher ratings, the non-significant result (S-Bχ^2 = 2.20, $p < .14$) indicated that the model reproduced the population covariance matrix. While only one index (CFI = 1.0) provided a perfect fit to the data, the remaining indices (GFI = .99, NNFI = .98, RMSR = .006, RMSEA = .070, and PNFI = .17) provided extremely good fit statistics.

Similar to teacher ratings, for parent ratings, the non-significant result (S-Bχ^2 = .073, $p < .79$) indicated that the model fitted the data, in that the model reproduced the population covariance matrix. Also, for several indices (CFI = 1.0, GFI = 1.0, NNFI = 1.0, and RMSEA = 0.0) the values provided a perfect fit to the data, while the remaining indices (ECVI = .09, RMSR = .001, and PNFI = .17) provided extremely good fit statistics.

Taken together, for both teacher and parent ratings, the results of the CFA parcel model showed very strong support for the two-factor DSM-IV structure of the ADHD symptoms.

4 . 10 Testing for convergent validity and discriminant validity of the ADHD symptoms at the matrix level: Comparison of models

The postulated model (Model 1) is shown in Figure 4. At the matrix level the postulated multitrait-multisource model is compared with a nested series of more restrictive models. Table 16, shows the goodness-of-fit indices for the models of the ADHD symptom parcels at the matrix level.

As can be seen Model 1 provided an overall better fit to the data than Models 2, 3, and 4, and overall Model 1 provided a very good fit (CFI = .99; GFI = .97; NNFI = .97; RMSR = .029; RMSEA = .067; ECVI = .32). As will be noticed, Model 1 provided a significantly better fit than Model 2. A significant difference in S-Bχ^2, and the lower RMSR, and RMSEA indices in Model 1 than Model 2, provided good support for the convergent validity at the matrix level.

Table 16

Goodness-of-Fit Indices for Multitrait-Multisource Models of ADHD Symptom Parcels

Model*	df	χ^2	S-Bχ^2	CFI	GFI	NNFI	ECVI	RMSR	RMSEA	PNFI
Model 1	11	22.90*	22.00*	.99	.97	.97	0.32	.029	.067 (.023-.11)	.38
Model 2	20	620.92	447.78	.39	.64	.15	2.16	.21	.31 (.29-.31)	.28
Model 3	12	140.58	111.70	.87	.89	.70	0.72	.077	.19 (.17-.21)	.37
Model 4	12	142.62	119.08	.87	.89	.69	.0.75	.076	.20 (.17-.23)	.37

Note: χ^2 = minimum fit function chi-square; S-Bχ^2 = Satorra-Bentler scaled chi-square; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation, values in brackets = 90% confidence interval; PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, RMSR, RMSEA and ECVI, and higher values for

CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 values were significant at $p < .001$, unless indicated, * $p = < .025$. *M 1 = Model 1 (freely correlated traits; freely correlated sources). M 2 = Model 2 (no traits; freely correlated sources). M 3 = Model 3 (perfectly correlated traits; freely correlated sources). M 4 = Model 4 (freely correlated traits; perfectly correlated sources).

Table 17 shows differential fit indices. The ΔS-Bχ^2 difference was highly significant ($\chi^2_{(9)} = 330.53, p < .001$), and the difference in practical fit of the measures (ΔCFI = .60; ΔGFI = .33; ΔNNFI = .82; ΔPNFI = .10; ΔECVI = 1.86) was substantial thereby providing strong support for the convergent validity of the traits.

Table 17

Differential Goodness-of-Fit Indices for Multitrait-Multisource Model Comparisons for ADHD Item Parcels

Model*	Δdf	$\Delta\chi^2$	ΔS-Bχ^2	ΔCFI	ΔGFI	ΔNNFI	ΔECVI	ΔRMSR	ΔRMSEA	ΔPNFI
Test of convergent validity										
M1 vs M2 (traits)	9	598.02	330.53	.60	.33	.82	1.84	.18	.24	.10
Test of discriminant validity										
M1 vs M3 (traits)	1	117.68	32.22	.12	.08	.27	.40	.05	.12	.01
M1 vs M4 (sources)	1	119.72	40.97	.12	.08	.28	.43	.047	.13	.01

Note: χ^2 = minimum fit function chi-square; S-Bχ^2 = Satorra-Bentler scaled chi-square; CFI = comparative fit index; GFI = goodness-of-fit index; NNFI = non-normed fit index; ECVI = expected cross-validation index; RMSR = root mean square residual; RMSEA = root mean square error of approximation; PNFI = parsimony normed fit index. Lower values of χ^2, S-Bχ^2, NCP, RMSR, RMSEA, and ECVI, and higher values for CFI, GFI, NNFI, and PNFI indicate a better fit. All χ^2 values were significant at $p < .001$. *M1 = Model 1 (freely correlated traits; freely correlated sources). M2 = Model 2 (no traits; freely correlated sources). M3 = Model 3 (perfectly correlated traits; freely correlated sources). M4 = Model 4 (freely correlated traits; perfectly correlated sources).

Table 17 also shows the test of the discriminant validity of the traits. The greater the discrepancy between the indices of fit, the stronger the support for evidence of discriminant validity. Model 1 compared with Model 3 revealed a ΔS-Bχ^2 value, that was highly significant (ΔS-B$\chi^2_{(1)} = 32.22, p < .001$), and the difference in practical fit was small to moderate (ΔCFI = .12; ΔGFI = .08; ΔNNFI = .28; ΔPNFI = .01; ΔECVI = .048) which suggested only modest evidence of discriminant validity at best.

Testing the discriminant validity of the sources involved comparing Model 1 with Model 4. A significant ΔS-Bχ and substantial change in the fit indices indicates a lack of discriminant validity, and thus common method bias across methods of measurement. As shown in Table 17, this comparison yielded a ΔS-Bχ^2 that was highly significant (ΔS-B$\chi^2_{(1)} = 40.97$, $p < .001$), and the difference in practical fit was generally only small to moderate across all measures (ΔCFI = .12; ΔGFI = .08; ΔNNFI = .28; ΔPNFI = .01; ΔECVI = .43). Given the significant ΔS-Bχ^2 value, and the pattern of small to moderate differences between the fit indices, these results provide greater support for the discriminant validity of the sources than the discriminant validity of the traits at the matrix level.

4 . 11 <u>Testing for convergent and discriminant validity of the ADHD symptom parcels: Comparison of individual parameters</u>

For Model 1, the postulated model, the convergent validity of the different symptom parcels is represented by the magnitude of the trait loadings. Trait loadings are squared to determine the amount of trait, source, and error variance in the symptom parcels. Table 18, shows the amount of trait, source and error variance in the postulated model of ADHD symptom parcels.

Table 18

Variance in Teacher and Parent Ratings of ADHD Symptom Parcels Accounted for by Trait, Source and Error Effects

Measures	Trait	Source	Error
	Teacher ratings		
IA (odd items) Parcel 1	.12	.88	.00
IA (even items) Parcel 2	.08	.67	.25
H/I (odd items) Parcel 1	.55	.30	.15
H/I (even items) Parcel 2	.71	.27	.02*
Average			
IA	.10	.78	.12
H/I	.63	.29	.08

Table 18, continued

	Parent ratings		
IA (even items) Parcel 1	.59	.10	.31
IA (odd items) Parcel 2	.74	.07	.19
H/I (even items) Parcel 1	.18	.64	.18
H/I (odd items) Parcel 2	.20	.76	.04*
Average			
IA	67	09	25
H/I	19	70	11

Note. IA: inattention; H/I: hyperactivity-impulsivity; The trait, source and error components sum to 1.0 for each symptom within rounding error. All values were significant at $p < .001$ unless non significant as indicated *. Values are the standardised loadings squared.

For both teachers and parents, all trait and source loadings were significant for the IA and H/I symptoms. Teacher H/I and parent IA symptom parcels had greater trait variance than source variance, whereas teacher IA and parent H/I symptom parcels had greater source than trait variance.

For teachers, the H/I parcels 1 and 2 contained 55% and 71% trait variance, and 30% and 27% source variance, respectively. Given the high trait variance for the H/I parcels, and low source and error variance, these results provided good support for the convergent validity of the teacher H/I traits. The teacher IA parcels 1 and 2 contained 12% and 8% trait variance, and 88% and 67% source variance, respectively. These results did not support the convergent validity of the teacher IA traits. By contrast, parent IA symptom parcels contained 59% and 74% trait variance, and 10% and 7% source variance, respectively. Given the high trait variance for the IA parcels, and low source and error variance, these results support the convergent validity of the parent IA traits. The parent H/I parcels 1 and 2 contained 18% and 20% trait variance, and 64% and 76% source variance, respectively. Given the high source variance, these results do not support the convergent validity of the parent H/I traits. Taken together, these results provided good support for the convergent validity of the teacher H/I and parent IA symptoms, but less support for the convergent validity of the teacher IA and parent H/I symptoms.

The discriminant validity of the traits and sources involves examination of the factor correlation matrix. As previously noted, correlations among traits and sources should be negligible to satisfy evidence of discriminant validity. Table 19 shows that the correlations between the IA and H/I traits, and teacher and parent sources were -.06 and -.15 respectively. These results have indicated a non-significant and negative relationship for traits and sources, thereby providing evidence of the discriminant validity of IA from H/I, and teacher ratings from parent ratings.

Table 19

Trait and Source Correlations for Multitrait-Multisource Model of ADHD Symptom Parcels

	Traits		Sources	
	IA	H/I	Teacher	Parent
IA	1.00	-.06 ns		
H/I		1.00		
Teacher			1.00	-.15 ns
Parent				1.00

Note. IA: inattention; H/I: hyperactivity-impulsivity. $p < .001$. ns = non-significant.

4 . 12 Discussion

4 . 12 . 1 Exploratory factor analysis

EFA generally confirmed the two-factor structure of the ADHD symptoms proposed in DSM-IV, and as conceptualised in contemporary theories of the disorder (Barkley, 1997; Quay, 1996). For both teacher and parent ratings the H/I dimension constituted factor 1 and the IA dimension factor 2. Consistent with past data (as shown in Table 1), this study generally supported a factor model comprising IA and H/I as two separate dimensions for both clinical samples (Bauermeister, 1992; McBurnett et al., 2001; Wolraich et al., 1998) and normative samples (Brito et al., 1995; DuPaul, 1997, 1998; Holland et al., 1998;

Hudziak et al., 1998; Pelham, Gnagy et al., 1992, Pelham, Evans, et al., 1992; Rohde et al., 2001; Weiler et al., 1999; Yang et al., 2000).

In the current study there were some differences between the teacher and parent data with teachers supporting the two-factor structure of IA and H/I, and parents supporting a three-factor structure comprising HYP as the first factor, IA as the second factor, and IMP as the third factor. Examination of the parent three-factor model, showed higher correlations between the H/I dimensions (i.e., HYP and IMP factors), than between the IA dimension and the H/I dimension. Given the high correlation between the HYP and IMP factors shown in previous studies (Burns et al., 2001; Gomez et al., 1999), it is suggested that the two-factor EFA model is an appropriate preliminary organisation of the ADHD symptoms.

4 . 12 . 2 Structural organisation of the DSM-IV ADHD symptoms: Use of CFA to test one, two, and three factor models

CFA analysis of the 18 ADHD symptoms indicated that for the different models proposed, the goodness-of-fit indices consistently provided support for the two and three factor models over the one factor model. There was little differentiation between the fit indices for the two- and three-factor models. The fit indices for the two- and three-factor models showed that only a few measures provided a very good fit to the specified models. Nevertheless, that the remainder of the indices provided a good, acceptable, or marginal fit for both the two- and three-factor models suggests that both the two- and three-factor models provide a reasonable conceptualisation of the structure of the DSM-IV ADHD symptoms. Although to date no other CFA study has examined clinical samples of ADHD only children, these results were quite consistent with the results found for the normative samples of similar age Australian and Brazilian children (Gomez et al., 2003).

In addition, with respect to the relative merits of two- and three-factor ADHD models, examination of the correlation coefficients in the three-factor model showed a high correlation between the HYP and IMP dimensions, and Fisher *r* to z transformation tests showed this correlation was significantly higher than that for the correlations between IA and HYP, and IA and IMP. These results can be interpreted as indicating support for the two-factor model. As well, further support for the DSM-IV ADHD factorial structure was provided by tests of composite reliability and extracted variance. These tests showed good support for the internal consistency of the DSM-IV two-factor structure. Given the above findings, to more closely approximate the current DSM-IV symptom organisation, CFA parcel analysis of the ADHD symptoms was executed for the two-factor model. The results indicated a very good fit to the data, and thus further confirmed the DSM-IV two-factor model as an appropriate representation of the ADHD symptom organisation.

Taken together, the findings here extend existing data, in that this study provides support for the DSM-IV two-factor model in children with a confirmed ADHD diagnosis. This has not been shown previously with CFA. This finding here implies that the division of the eighteen ADHD symptoms into the two dimensions of IA and H/I for diagnostic purposes, as given in DSM-IV, is more appropriate than a three dimensional model (DSM-III) or unidimensional model (DSM-III-R).

4 . 12 . 3 Convergent and discriminant validity of the ADHD symptom parcels at the matrix level

The CFA MTMS parcel analyses at the matrix level showed that Model 1 (the postulated model) provided a better fit to the data than Models 2, 3, and 4. In addition, based on the goodness of fit indices, there was qualified support for the convergent validity of the DSM-IV IA and H/I dimensions of the ADHD construct. Although these findings pertained to ADHD diagnosed children they were nevertheless quite consistent with those of two earlier studies using normative samples (Burns et al., in press; Gomez et al., 2003). By contrast, while there was only modest evidence of discriminant validity between the IA and H/I dimensions, there was more support for discriminant validity between the sources. These findings may be compared with those in the normative samples. For instance, in the study by Burns et al. (in press), within and across a three-month time interval, there was good discriminant validity of the IA and H/I factors, but there was weaker support for the discriminant validity of the sources. The Gomez et al. (2003) study found statistical support for the discriminant validity of traits and sources, but the effect was quite modest. Taken together, at the matrix level the results for the normative samples, and the diagnosed children in the current study, suggested greater support for the discriminant validity of the sources than the traits.

4 . 12 . 4 Trait, source and error variance in the ADHD symptom parcels

At the individual parameters parcel level, the results in the current study showed greater trait than source effects for teacher H/I and parent IA, and greater source than trait effects for teacher IA and parent H/I. These findings are quite consistent with the findings reported previously for normative samples (Burns et al., in press; Gomez et al., 2003).

Taken overall, the findings in this study and the two normative studies, have evidenced a pattern of greater source than trait effects. That the sample of ADHD children in the current study, as well as the normative samples from other countries evidenced similar patterns of greater source effects suggests a common explanation for this phenomenon. Fiske (1987), and Buckley, Cote, and Comstock (1990) have suggested that higher source effects may be related to measurement artefacts associated with rater characteristics such as coding errors, halo effects, constant tendency effects, projection bias, and response bias. Second it may be that higher source variance also reflects the effects of source specific behaviour that differentiated between teacher and parent ratings. Within such an interpretation, either teachers or parents, as separate sources, provide an accurate, but context specific rating of the child's behaviour. However the third, and the most probable explanation for higher source variance is that higher source variance represents an amalgam of measurement artefacts and source specific behaviour (Burns et al., in press). In the light of the CFA and CFA MTMS findings of the current study, and the similar findings in past studies, these issues will be included as part of the discussion in the concluding chapter. A substantial part of this chapter will deal with implications for the conceptualisation, assessment, and treatment of ADHD.

CHAPTER 5

DIFFERENCES AMONG ADHD SUBTYPES

5 . 1 Introduction

Chapters 3 and 4 focused on an examination of structural validity as an important element within the first stage of establishing the construct validity of ADHD. The second stage of construct validity is external validity. External validity generally refers to the extent to which a test correlates with external variables, such as self-report measures, parent or peer ratings, and laboratory or biological indices that would be expected to relate to the construct on theoretical grounds.

Initially this chapter will briefly elucidate the process necessary to establish the external validity of a clinical disorder such as ADHD. Subsequently the main part of this chapter will provide a critical review of past DSM studies that have focused upon the external validity of ADHD.

5 . 2 Establishing the external validity of ADHD

To test the external validity of ADHD there has generally been two major approaches (Loevinger, 1957; Robins & Guze, 1970). One approach has been to examine differences between individuals with different disorders. For instance in the context of ADHD, this approach involves an examination of how ADHD differs from say ODD or CD, and how the three ADHD subtypes differ from each other. Another approach has been to examine the correlates of the ADHD constructs (inattention, hyperactivity, impulsivity) with other constructs (e.g., ODD, aggression, anxiety, peer relationships). This chapter will use this approach to review past studies that have examined how the different ADHD subtypes differ from each other on measures not used to define their clinical grouping.

As pointed out earlier, this study is aimed at establishing the external validity of the different DSM-IV subtypes. More specifically, this study will compare the IA, H/I, and C subtypes, and normal controls on a number of child, teacher and parent variables. The child variables include IQ and academic functioning, social cognition, and child perception of parent-childrearing style. The teacher and parent variables include ratings of child ODD symptoms, anxiety, aggression style, parenting style, and parent mental health.

As noted previously DSM-III distinguished between ADD with hyperactivity (ADDH) and ADD without hyperactivity (ADD). DSM-III-R made no distinction between subtypes. While the ADDH and ADD diagnoses of DSM-III may be relatively comparable to the combined subtype and the inattentive subtype diagnoses of DSM-IV respectively, there are differences in diagnostic symptoms. In addition with DSM-IV, it is also possible to diagnose a new hyperactivity-impulsivity subtype.

In view of these differences this chapter will initially examine the subtypes separated for diagnosis based on DSM-III and DSM-IV. Only studies that have selected subjects using the relevant DSM criteria (i.e., DSM-III ADD criteria, and DSM-IV ADHD criteria) are included in this review.

The first part of this chapter will provide a comprehensive review of the subtype studies in DSM-III, and DSM-IV, respectively, under the following subheadings: aggressive and externalising behaviours, neuropsychological, neurological, psychophysiological and motor functioning, IQ and academic functioning, internalising behaviour disorders, family functioning and parent mental health, and peer relations.

The second part of this chapter will examine several variables that have not been examined for different ADHD subtypes. An examination of these variables may provide additional support (or test) of the validity of the different ADHD subtypes. These variables include child social cognition, and child perception of parent-childrearing style, and parent perception of child aggression style.

5 . 3 Part 1: Existing subtype studies based on DSM-III and DSM-IV diagnostic criteria

During the past two decades numerous researchers have endeavoured to evaluate differences among subtypes in the two DSM editions (DSM-III and DSM-IV) stipulating the use of subtypes. Generally the aim of these studies has been to develop a greater understanding of differences among ADHD children in order to improve diagnosis, assessment and treatment options, as well as to increase understanding of the comorbidity of the subtypes with other disorders such as ODD, anxiety, or learning disorders.

5 . 3 . 1 Aggressive and externalising behaviours

5 . 3 . 1 . 1 Studies based on DSM-III diagnostic criteria

As shown in Table 20, past DSM-III based studies in this area have shown that ADDH children have more conduct problems, aggression, and antisocial behaviours than ADD and control children (Baumgaertel et al., 1995; King & Young, 1982; Lahey, Schaughency, Hynd, Carlson, & Nieves, 1987; Lahey, Schaughency, Frame, & Strauss, 1985). Also ADDH children were found to have more overall school and home behaviour problems compared to ADD and control children (Berry et al., 1985; Edelbrock, Costello, & Kessler, 1984). For the Lahey et al. (1987) study, when children with comorbidity with CD were removed, there were no differences between the ADD and ADDH groups for conduct problems. In addition, in the study by Carlson, Lahey, Frame, Walker, and Hynd (1987), screening for comorbidity with CD removed the differences between the subtypes for externalising behaviours.

With respect to differences between children with ADD (ie., without hyperactivity) and control children, Table 20, also shows that, in general, ADD children have more conduct problems and aggression than control children (Barkley et al., 1990; Baumgaertel et al., 1995; Carlson et al., 1987; Edelbrock et al., 1984; King & Young, 1982; Lahey et al., 1984). However there is also data for aggressive behaviours at home and/or school showing no differences between ADD children and controls (Berry et al., 1985).

5 . 3 . 1 . 2 Studies based on DSM-IV diagnostic criteria

As will be noticed in Table 20, past studies indicate that, compared with the IA subtype and controls, the C subtype have more externalising problems, conduct problems, delinquency and aggression (Baumgaertel et al., 1995; Crystal et al., 2001; Eiraldi, Power, & Nezu, 1997; Faraone et al., 1998; Gaub & Carlson, 1997a), higher incidence of ODD and CD (Dane, Schachar, & Tannock, 2000; Nolan, Volpe, Gadow, & Sprafkin, 1999; Nolan et al., 2001; Teegarden & Burns, 1999), and more school and home behavioural problems (Gaub & Carlson, 1997a; Lahey et al., 1998; Wheeler & Carlson, 2000).

In general, most studies in this area have found few differences for externalising problems, conduct problems, delinquency and aggression between the C subtype and H/I subtype (Lahey et al., 1998; Lamminmaki, Ahonen, Narhi, & Lyytinen, 1995; McBurnett et al., 1999; Paternite et al., 1996; Wolraich et al., 1996). Also the H/I subtype was found in these studies to have more externalising problems, conduct problems, delinquency (Lahey et al., 1998; Lamminmaki et al., 1995; McBurnett et al., 1999), and higher incidence of ODD and CD (Eiraldi et al., 1997; Gaub & Carlson, 1997a; Teegarden & Burns, 1999) compared with the IA subtype and control children.

In relation to IA and control children, the existing data appear equivocal. Some studies have found no differences between these groups for aggression and conduct problems (Faraone et al., 1998; Lahey et al., 1998; Lamminmaki et al., 1995; Willcutt et al., 1999) and ODD/CD symptoms (Dane et al., 2000; Teegarden & Burns, 1999; Wheeler & Carlson, 2000). Other studies have reported more aggression and conduct problems in the IA group (Crystal et al., 2001; Gaub & Carlson, 1997a; Eiraldi et al., 1997), and also more ODD and CD among IA children than control children (Nolan et al., 2001; Ostrander, Weinfurt, Yarnold, & August, 1998; Paternite et al., 1996; Willcutt et al., 1999). For the few studies examining overall school and home behaviour, comparisons between ADHD subtypes have also produced equivocal results. Two studies indicated IA children to have more problem behaviours than controls (Gaub & Carlson, 1997a; Lahey et al., 1998), while one study found no difference between IA children and controls (Wheeler & Carlson, 2000).

Finally, several studies screened for the effects of comorbidity with ODD and/or CD. One study (Paternite et al., 1996) showed that ADHD children with comorbid ODD/CD had more pervasive problems at home and school than ADHD children without comorbidity. Another study (Teegarden & Burns, 1999), measured and compared the level of comorbidity in IA and C subtypes at initial screening, and one year later, and found that at both intervals the C subtype had significantly higher ODD/CD symptoms than the IA subtype. Also, screening for comorbidity with ODD/CD resulted in both IA and C children having lower externalising problems than when the subtypes were unscreened for ODD/CD comorbidity (Eiraldi et al., 1997). It was interesting that one of the very few studies comparing IA and H/I subtypes independent of the C subtype, found that the H/I subtype was more likely to have a comorbid ODD/CD secondary disorder than the IA subtype (Decker, McIntosh, Kelly, Nicholls, & Dean, 2001).

5.3.1.3 Summary and integration of findings based on DSM-III and DSM-IV criteria

Taken together the findings of studies based on DSM-III criteria for ADD, have generally suggested that ADDH children have more aggression, conduct problems, antisocial behaviours, home and school behaviour problems than ADD children. The evidence also shows that both ADD and ADDH children may have more problems in these areas compared to control children. Studies based on DSM-IV criteria, can be interpreted as indicating that for aggression, conduct problems, delinquency, ODD and CD, H/I and C children do not generally differ from each other, and that children with both these ADHD subtypes have more problems than children with the IA subtype. With respect to controls, evidence suggests greater disparity between children with hyperactivity-impulsivity (i.e., H/I and C subtypes) than children with inattention (i.e., IA subtype). Also, children with the IA subtype would generally have more problems in these areas compared to control children. These findings have been found even when the presence of ODD/CD was screened or statistically controlled in the analyses.

5.3.2 Neuropsychological variables

5.3.2.1 Studies based on DSM-III diagnostic criteria

The results for the neuropsychological variables are difficult to interpret. As shown by Table 20, several studies found no differences between the subtypes for specific neuropsychological measures (Barkley et al., 1992, Carlson et al., 1986) or differences between some measures and not others (Ackerman, Dykman, Holcomb,

& McCray, 1982; Ackerman, Dykman, & Oglesby, 1983; Barkley, DuPaul, et al., 1990). Despite the apparent inconsistency in results among the different studies, there is sufficient evidence to suggest that ADDH children have more neuropsychological problems related to inhibition and impulse control deficits than ADD children. In addition both the ADD and ADDH subtypes have more neuropsychological deficits than control children.

5.3.2.2 Studies based on DSM-IV diagnostic criteria

The data are based on studies mostly comparing the IA and C subtypes, and similar to the results for DSM-III studies, the studies have produced equivocal results. As shown by Table 20, several studies have demonstrated few systematic subtype differences across a range of measures (Houghton et al., 1999; Klorman et al., 1999; Nigg, Blaskey, Huang Pollock, & Rappley, 2002; Paternite et al., 1996). One of these studies has suggested that where differences do occur between the subtypes with inattention (i.e., IA and C subtypes), such differences may be related to differences between the tests, and different facets of executive functioning and motor inhibition (Nigg et al., 2002). Exemplifying this, two studies examining planning have produced contrasting results. One study found no differences for the Tower of London (Nigg et al., 2002), while in the other study the problem solving and rule violation subtests of the Tower of Hanoi, showed that the C subtype had lower performance than the IA subtype (Klorman et al., 1999). The latter authors suggested that differences between subtypes for executive functioning may be associated with regional differences in brain function and structure.

As shown in Table 20, several studies have focused on tests related to inhibition processes, and have produced either no subtype differences or mixed results. In one study commission and omission errors did not differentiate the IA and C subtypes (Paternite et al., 1996). Response inhibition time on a computer stop-task also failed to differentiate the IA and C subtypes (Nigg, 1999). A later study by the same author (Nigg et al., 2002) also found no differences between the same subtypes for a stop task. By contrast, two other studies did find subtype differences for inhibition (Chhabildas, Pennington, & Willcutt, 2001; Lockwood, Marcotte, & Stern, 2001).

5.3.2.3 Summary and integration of findings based on DSM-III and DSM-IV diagnostic criteria

Taken together, the data from both DSM-III and DSM-IV studies is equivocal and difficult to interpret. While the DSM-IV findings failed to show clear subtype distinctions across a range of measures, there is some evidence of qualitative differences in attention processing, in that different phases of different tests are able to show distinctions between the IA and C subtypes.

At best the data might indicate that there may be qualitative but non-systematic differences between the IA and C subtypes based on the type of subtest or measure used, rather than a broad band of consistent neuropsychological differences. At worst the data might be interpreted as indicating very few systematic differences between the two subtypes with inattention across the different DSM editions. With respect to the later DSM-IV edition, such an interpretation appears quite reasonable considering that in all but one study, only the IA and C subtypes have been compared, and the core symptom of inattention is common to both subtypes. Indeed several researchers have suggested that purely inattentive children (i.e., IA subtype) have more problems with distractibility, processing speed, auditory recall, and overall motor activity. By contrast, children with both inattention and hyperactivity-impulsivity (i.e., C subtype) have more problems inhibiting responses, especially under difficult contingency conditions (i.e., boring, repetitive, or tedious tasks).

With regard to comparisons between the IA and C subtypes and control children the picture is somewhat clearer. There is stronger support for distinctions in overall neuropsychological function between the C subtype and control children. The relationship between the IA subtype and controls is less clear although there is limited evidence to indicate that the IA subtype has marginally more neuropsychological impairment than control children. The lack of studies precludes speculation concerning any pattern of association between the H/I subtype and control children.

5.3.3 Neurological, psychophysiological and motor activity variables

5.3.3.1 Studies based on DSM-III diagnostic criteria

One neurological study found no subtype differences for EEG data (Holcomb, Ackerman, & Dykman, 1985), while another found that ADDH children had slower event related potentials than ADD children for a prior to reward condition of pre-test attention, but these differences were no longer apparent during the test and under a non-reward condition (Ackerman et al., 1982). A neurological examination found ADDH children had more neurological and cognitive abnormalities and a higher frequency of pre-natal and peri-natal problems than ADD children (Frank & Ben-Nun, 1988). Studies examining psychophysiological measures found no subtype differences for ankle and wrist actometer readings (Barkley, DuPaul, et al., 1990). A heart rate study found higher heart rate for ADDH children, compared to ADD children, during a warned reaction time task (Dykman & Ackerman, 1991). However, it was only under the reward condition that there were significant subtype differences, as under the non-reward conditions both subtypes did not differ. Finally, a task testing the motor activity ability to copy patterns under reward and non-reward conditions (ie., pegboard, mazes, embedded figures) failed to find subtype differences (Barkley et al., 1992).

5.3.3.2 Studies based on DSM-IV diagnostic criteria

Clarke, Barry, McCarthy, and Selikowitz (1998), found differences in wave frequency and severity between the IA and C subtypes, and between the subtypes and controls. The readings of the IA group were intermediate between the C group and control group. Two later studies by the same team differentiated the IA and C subtypes in the relative and absolute values of the different wave readings (Clarke, Barry, McCarthy, & Selikowitz, 2001a, 2001b). It was concluded that there may be qualitative differences in the neuroanatomical systems of the subtypes, with the C subtype largely associated with frontal lobe dysfunction, whereas the IA subtype may have other forms of central nervous system dysfunction, not necessarily associated with frontal lobe functioning. They also suggested that these changes might be related to age, gender, and maturational change. Finally supporting this approach, a study examining event related potentials has suggested that differences between the IA and C subtypes are non-systematic, and they probably reflect qualitative differences in information processing deficits, that in turn are related to age and maturational effects (Johnstone, Barry, & Anderson, 2001).

One physiological study found no subtype differences when comparing readings during free play or classroom time (Paternite et al., 1996). Another study (Dane et al., 2000), found no IA and C subtype differences in overall actigraph scores, but did find differences between subtype and control children, according to time of day. It was suggested that these differences are related to greater motor activity in the ADHD children compared to normal children. Finally a test of motor activity using a paper and pen complex figures task revealed that IA children performed more poorly than C children (Lockwood et al., 2001).

5.3.3.3 Summary and integration of findings based on DSM-III and DSM-IV diagnostic criteria

Studies based on DSM-III diagnostic criteria for psychophysiological, EEG, and motor activity found few consistent differences between the ADD and ADDH subtypes. More recent studies based on DSM-IV diagnostic criteria have only compared the IA and C subtypes. While finding relatively similar results to the DSM-III based studies, they have also suggested that differences between subtypes may be subtle, and related to qualitative differences in neuroanatomical structures. In particular, the C subtype was likely to be more associated with frontal lobe dysfunction than the IA subtype. It was also suggested that these differences are differentially related to age, gender, and maturational factors. Few studies examined control group children, but those that did found only very minimal differences between subtype and control children.

5.3.4 IQ and academic functioning

5.3.4.1 Studies based on DSM-III diagnostic criteria

As shown in Table 20, in general, for IQ the results have indicated few differences between the ADD and ADDH subtypes. Several studies found few IQ (verbal or performance) differences between ADD and ADDH (Berry et al., 1985; Casey, Rourke, & DelDotto, 1996; Hynd et al., 1991), but one study (Carlson et al., 1986) found ADD children to have higher IQ than ADDH children. In relation to specific core academic areas there were mixed results for maths (Carlson et al., 1986; Hynd et al., 1991; Marshall, Schafer, O'Donnell, Elliott, & Handwerk, 1999), but the results for the language and verbal area were less equivocal with fewer subtype differences being found for reading, language and verbal skills (Carlson et al., 1986; Hynd et al., 1991; Marshall et al., 1999). Finally, two studies provided contrasting results for special education and grade retention. One study indicated ADD children to have greater grade retention than ADDH children (Edelbrock et al., 1984), but a second study revealed ADDH children to have greater grade retention than ADD children (Barkley, DuPaul, et al., 1990).

The limited number of studies comparing ADD subtypes and control children also produced mixed results. For IQ, two studies found that both ADD subtypes differed from control children (Barkley, DuPaul et al., 1990; Berry et al., 1985), while another found that ADDH children had lower Full Scale IQ than control children (Carlson et al., 1986). As well, for core learning areas (reading, spelling, and maths) and special education and grade retention, the ADD groups differed from control children.

5 . 3 . 4 . 2 Studies based on DSM-IV diagnostic criteria

In general, as shown by Table 20, the limited number of results indicated no systematic differences among the subtypes for IQ, including Verbal and Performance subscales. One study examining the three subtypes demonstrated the H/I subtype to have higher IQ than the IA and C subtypes (Willcutt et al., 1999), and another comparing only the IA and C subtypes, found the C subtype to have higher IQ than the IA subtype (Vaughn, Riccio, Hynd, & Hall, 1997). Several studies investigating achievement in core learning areas have found no differences for reading and maths (Faraone et al., 1998; Lamminmaki et al., 1995; Paternite et al., 1996; Wheeler & Carlson, 2000). Another study indicated the IA and C subtypes to have more maths and reading disorders than the H/I subtype, but after screening for the effects of conduct problems, the IA group had more maths disorders than the C group, but there were no differences for reading disorders (Morgan, Hynd, Riccio, & Hall, 1996). Lahey et al. (1998) adjusted for the presence of ODD, and internalising problems, and found no intelligence-reading differences, but did find the IA and C groups had lower intelligence-maths difference scores than H/I and control children. Despite these findings, the results for special education referral were mixed, with studies either finding no subtype differences (Lahey et al., 1998), or the IA and C subtypes to have more need for special education (Faraone et al., 1998; Nolan et al., 2001). With respect to the subtypes and control group, most studies found no differences for IQ, however there was some evidence to suggest that the H/I and control groups had higher IQ and overall academic functioning than the IA and C groups.

5.3.4.3 Summary and integration of findings based on DSM-III and DSM-IV diagnostic criteria

Taken together these findings indicate that studies based on DSM-III criteria have generally indicated a pattern that does not provide clear distinctions between the ADD subtypes. For IQ, studies have indicated either no differences or mixed results. For academic performance, there was greater support for ADD children having more problems in core learning areas than ADDH children, and in particular, ADD children appeared to have greater math problems than ADDH children. No differences were found for overall language performance, but there was some evidence suggesting that ADD children had more spelling-related learning problems than ADDH children.

Studies based on DSM-IV criteria for ADHD also produced a pattern of mixed results. In general, while few differences have been found between the IA and C subtypes, findings suggest that the H/I subtype more closely approximate the control group than the other two ADHD subtypes. H/I children generally do not differ from the control group and both groups appear to have higher IQ and fewer problems and greater achievement in all core-learning areas.

The results suggest that, in general, ADHD children with core symptoms of inattention (either the IA subtype or C subtype) differ from ADHD children with only ADHD core symptoms of hyperactivity-impulsivity (HI subtype). Thus ADHD children with only hyperactivity-impulsivity will have higher IQ and less learning problems than ADHD children with inattention only, or both inattention and hyperactivity-impulsivity. Moreover, when conduct problems are screened it appears that when comparing both groups with inattention disorders that IA children rather than C children have a specific maths disorder, whereas differences between these groups appear less pronounced for reading disorders.

5.3.5 Internalising behaviours

The internalising behaviours are reviewed below under the headings: anxiety, depression, and other internalising behaviours

5.3.5.1 Anxiety studies based on DSM-III diagnostic criteria

In general, as shown by Table 20, the results of studies in this area have produced mixed findings. Studies have shown no difference between ADD and ADDH children (Cantwell & Baker, 1992), as well as higher anxiety among ADD children than ADDH children (Lahey, Schaughency, Strauss, & Frame, 1984). Lahey et al. (1987) also found high anxiety among ADDH children. However this difference did not exist when conduct problems were screened. Existing data also show more anxiety among both ADD and ADDH groups compared to normal controls (Barkley, DuPaul, et al., 1990). Taken together, these findings suggested that ADD and

ADDH children will have more anxiety than normal control children. Also ADD children may have more anxiety than ADDH children when conduct problems are not screened. When conduct problems are screened such differences are likely to be minimised.

5 . 3 . 5 . 2 Anxiety studies based on DSM-IV diagnostic criteria

In general, as shown by Table 20, the results of the limited number of studies in this area have produced minimal differences between the ADHD subtypes. Nevertheless a few studies have shown differences between subtypes. One study showed the C subtype to have greater anxiety than the IA subtype (Ostrander et al., 1998), and another showed the C subtype to have greater anxiety than both the H/I and IA subtypes who did not differ from each other (Gaub & Carlson, 1997a). One study showed that the C subtype had greater anxiety in preschool and primary school boys than the H/I and IA subtypes who did not differ from each other (Nolan et al., 2001). However at secondary school the C and H/I subtypes had greater anxiety than the inattentive subtype. Overwhelmingly, the studies showed the ADHD subtypes to have greater anxiety than control children. Willcutt et al. (1999) reported that comorbidity with ODD/CD did not differentiate between children with hyperactivity-impulsivity (i.e., H/I and C subtypes) or children with inattention (i.e., IA and C subtypes). By contrast, another study comparing the IA and C subtypes only, found that after screening for conduct problems, the C subtype had more anxiety than the IA subtype (Ostrander et al., 1998). Taken together, the results are somewhat inconclusive, although the evidence appears to suggest that anxiety is marginally more associated with the combined effects of inattention and hyperactivity (i.e., C subtype) than the separate effects of inattention (i.e., IA subtype), or hyperactivity-impulsivity (i.e., H/I subtype). This suggests that inattention is slightly more associated with anxiety than hyperactivity and/or impulsivity, thereby IA and C children will have slightly more anxiety than H/I children, or control children.

5 . 3 . 5 . 3 Depression studies based on DSM-III diagnostic criteria

The limited number of studies has shown no differences between ADD and ADDH children (Cantwell & Baker, 1992), as well as higher depression among ADDH than ADD children (Barkley, DuPaul, et al., 1990). Lahey et al. (1987) indicated that in children unscreened for conduct problems there were no subtype differences, but when the sample was screened for conduct problems, ADD children had more depression than ADDH children. Existing data also show more depression between both ADD and ADDH children than control children. Overall, these findings indicated that both ADD and ADDH subtypes have more depression than normal controls and there are few differences between the ADD and ADDH subtypes.

5 . 3 . 5 . 4 Depression studies based on DSM-IV diagnostic criteria

Table 20 shows that, in general, the results of studies in this area produced mixed findings. Studies have shown no difference between the IA and C subtypes (Eiraldi et al., 1997; Morgan et al., 1996; Vaughn et al., 1997), no difference between the IA and H/I subtypes (Gaub & Carlson, 1997a), as well as no difference between the H/I and C subtypes (Willcutt et al., 1999).

One study suggested that among older children, the subtypes with inattention (i.e., C and IA subtypes) were more likely to have greater depression than the subtype with purely hyperactivity-impulsivity. Other studies have found the C subtype to have more depression than the IA and H/I subtypes (Crystal et al., 2001; Faraone et al., 1998), or the IA subtype to have greater depression than the H/I and C subtypes (Willcutt et al., 1999). The latter study indicated that the symptoms of inattention were uniquely associated with depression, and it was suggested that comorbidity between ADHD and depression may be almost entirely dependent upon the level of inattention.

Another study (Ostrander et al., 1998), found that prior to screening for conduct problems the C subtype had more depression than the IA subtype, but after screening for conduct problems there were no subtype differences. Existing data clearly show that the ADHD subtypes have greater depression than normal control children (Crystal et al., 2001; Gaub & Carlson, 1997a; Ostrander et al., 1998). Taken together, these findings suggested that the IA and C subtypes were associated with higher depression than either the H/I subtype or normal controls. This suggested that depression might be associated with only those subtypes that have significant inattention. When conduct problems are screened, differences between the IA and C subtypes are likely to be minimised.

5 . 3 . 5 . 5 Other internalising behaviour studies based on DSM-III diagnostic criteria

In general, as shown by Table 20 the results from the limited number of studies in this area have indicated either minimal differences between the ADD and ADDH subtypes (Barkley, DuPaul et al., 1990), or ADD children to have more other internalising problems than ADDH children (Cantwell & Baker, 1992). The one study including control children found both ADD and ADDH children to have more internalising problems than control children (Barkley, DuPaul, et al., 1990). None of the studies screened for conduct problems.

5 . 3 . 5 . 6 Other internalising behaviour studies based on DSM-IV diagnostic criteria

In general, as shown by Table 20, the results in this area produced mixed findings. Studies have shown no subtype differences (Eiraldi et al., 1997; Vaughn et al., 1997; Wheeler & Carlson, 2000), as well as more somatic problems among the C subtype in comparison to the IA subtype (Gaub & Carlson, 1997a), or greater withdrawal and somatic problems among the IA subtype in comparison with the H/I and C subtypes (Gadow et al., 2000; Morgan et al., 1996). Eiraldi et al. (1997) showed that after screening for conduct problems, children with the C subtype had fewer internalising problems than the IA subtype. Several studies show the ADHD subtypes to have more general internalising problems than control children (Eiraldi et al., 1997; Faraone et al., 1998; Wheeler & Carlson, 2000). Taken together, these findings suggested that children with inattention (i.e., IA and C subtypes) may have more general internalising problems than children with purely hyperactivity-impulsivity (i.e., H/I subtype), especially when conduct problems have not been screened. That, when conduct problems were screened these difficulties still maintained, further emphasises the central role of inattention to the development of general internalisng problems such as withdrawal or somatic problems.

5.3.5.7 Summary and integration of findings of all internalising behaviours based on DSM-III and DSM-IV criteria

Taken together these findings indicate that studies based on DSM-III diagnostic criteria have generally demonstrated fairly consistent results. The data suggested similar levels of anxiety, depression, and other internalising problems in both DSM-III subtypes. By contrast the studies based on DSM-IV have produced a slightly different picture. The majority of studies comparing the three subtypes indicate a consistent pattern in which the IA and C subtypes appeared to have slightly more internalising problems than the H/I subtype. It was notable that, despite the lack of significant differences between the ADHD subtypes, that in almost all studies the C subtype had the highest scores for a diverse range of measures of anxiety and depression. Controlling for the effect of conduct problems showed no distinctions between the IA and C subtypes for overall internalising behaviours.

Comparison with controls revealed that, for both DSM-III and DSM-IV, the different subtypes had more anxiety/depression and other internalising problems than controls. In summary, there is little evidence of subtype differences in internalising behaviours for DSM-III studies. By contrast, in the DSM-IV studies, differences between the subtypes, in particular for anxiety and depression, may be related to higher levels of inattention.

5.3.6 Family functioning

5.3.6.1 Studies based on DSM-III diagnostic criteria

The results of studies in this area indicated ADDH children to have more family functioning problems than ADD children (Barkley, DuPaul, et al., 1990; Lewis, 1992), and both the ADD and ADDH groups appeared to have more family-related problems than control children. Neither of the studies screened for conduct problems.

5.3.6.2 Studies based on DSM-IV diagnostic criteria

Table 20 shows that no consistent differences between the three ADHD subtypes were reported for family functioning problems (Faraone et al., 1998), family system maintenance (Paternite et al., 1996), and family conflict, cohesion and mother-child relationship problems (Gadow et al., 2000). One study (Graetz, Sawyer, Hazell, Arney, & Baghurst, 2001), while finding no subtype differences for overall family problems, found IA and H/I subtypes were involved in more positive family activities than the C subtype, but also found no subtype differences for family cohesion. Similarly, another study also found no subtype differences, but found that within the C subtype, those children with comorbid conduct problems had greater family cohesion and organisation problems than those C subtype children without comorbid conduct problems (Paternite et al., 1996).

With relation to the ADHD subtypes and controls, all studies found that the controls had lower rating scores on virtually all measures than the ADHD subtypes. In particular, the C subtype had more family cohesion and conflict problems than controls. Taken together, the results indicated that those children with both inattention and hyperactivity-impulsivity (i.e., C subtype) may have marginally more family-related problems than children with either inattention (i.e., IA subtype) or hyperactivity-impulsivity (i.e., H/I subtype).

5.3.6.3 Summary and integration of findings based on DSM-III and DSM-IV criteria

The DSM-III studies showed the ADDH subtype having more family functioning problems than the ADD subtype. By contrast, few subtype differences were found in the DSM-IV studies, although there was some evidence that the C subtype, and to a lesser degree the H/I subtype, had marginally more problems than the IA subtype. The limited data also suggested the C subtype to differ most from controls. Taken together the data indicated few subtype differences with the two subtypes with the dimensions of hyperactivity-impulsivity (i.e., H/I and C subtypes) perhaps having more family functioning difficulties than the subtype with inattention (i.e., IA subtype). Comorbidity with ODD/CD was shown to increase the level of family-related problems in the C subtype.

Table 20

Differences between Subtypes based on DSM-III, and DSM-IV Diagnostic Criteria

Author	Selection criteria	Rater	Subjects♦	Measures	Variable♣	Results#
Aggressive and externalising behaviour						
DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)*	Teacher & parent	C & NC: 6-11 years, N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	DBD Scale CBCL	P - Aggression & delinquency	ADDH > ADD > Ctl
					P - Home behaviour problems	ADDH > ADD > Ctl
					T - Aggression	ADDH > ADD = Ctl
					T - School behaviour problems	ADDH > ADD > Ctl
					School suspension	ADDH > ADD = Ctl
Berry et al. (1985)	I: DSM-III (Unscr-CP)	Teacher	C: 6-14 years, N=134, (B 102, G 32), Ctl: (B 62, G 32)	Yale Child Inventory	Unruly, fighting & loss of control	ADDH > ADD = Ctl
Cantwell & Baker (1992)	I: DICA RS: DSM-III (Unscr-CP)	Teacher & parent	C: 4-14 years, N=80, (B 50, G 30)	CBCL, Conners, Rutter Scales	T & P - ODD/CD	ADDH > ADD
Carlson et al. (1987)	I: K-SADS RS: SNAP (Scr-CP)**	Teacher & parent	C: 6-13 years, N=56, Ctl: N=45, (Gender ratios not given)	RBPC	T & P - Aggression	ADDH > ADD = Ctl
Edelbrock et al. (1984)	Q: Ch Beh Prof (Unscr-CP)	Teacher	C: 6-11 years, N=25; Ctl: N=62, (B only)	Child Behaviour Profile	School problem behaviour & adaptive function	ADDH > ADD > Ctl

Table 20, continued

Lahey et al. (1987)	I: K-SADS RS: SNAP (Scr-CP)	Teacher & parent	C: 6-13 years, N= 63, (B 80%, G 20 %) C: 6-13 years, Study A (Unscr) N= 63, (B 80%, G 20 %) Study B (Scr) N=32, (B 80%, G 20 %)	Conners, RBPC	Study A: Aggression & conduct problems Study B: Aggression & conduct problems	ADDH > ADD ADD = ADDH
Lahey et al. (1985)	Q: RBPC (Unscr-CP)	Teacher	NC: Gr 2-5, N=30; (B 22, G 8) Ctl: N=20, (B 14, G 6)	RBPC	Aggression & conduct problems	ADDH > ADD > Ctl
DSM-IV						
Baumgaertel et al. (1995)	I: Self-modified DSM-III & DSM-IV scales (Scr-CP)	Teacher	NC: 5-12 years, N=1064, (Gender ratios not given)	Generic behaviour rating scales	Conduct problems Externalising & aggression	ADDH > ADD H/I = C > IA
Crystal et al. (2001)	DICA-R-P (Unscr-CP)	Teacher & parent	NC: 6-11 years, N=309, Ctl: N=144, (Total sample, B 79%, G 21%)	CBCL, BASC BASC BASC	P - Aggression & conduct problems T - Aggression T - Conduct problems	C > IA > Ctl C > IA > Ctl IA = C > Ctl
Decker et al. (2001)	I: DSM-IV (Scr-CP)	Clinician	C: 3-18 years, N=287, (B 202, G 84, 1 subject not identified), Ctl: N=290, (B 182, G 108)	Woodcock	ODD/CD & explosive behaviour	H/I > IA
Eiraldi et al. (1997)	I: DICA-R-P (Scr-CP)	Teacher & parent	C: 6-12 years, N=53, (Gender ratios not given)	DSMD	T & P - Externalising	C > IA > Ctl
Faraone et al. (1998)	RS: SADSS–SCE (Modif) (Unscr-CP)	Parent	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135, (B 104, G 31)	CBCL	Delinquency Aggression	C > IA = H/I = Ctl H/I = C > IA = Ctl
Gadow et al. (2000)	RS: CSI-4	Parent	NC: 10-12 years, N=743,	CSI-4, Self-report	ODD/CD symptoms	H/I = C > IA > Ctl

Table 20, continued

	(Unscr-CP)		(Gender ratios not given)	CBCL	Delinquency Aggression	C > IA = H/I > Ctl H/I = C > IA > Ctl
				IOWA	Aggression	H/I > IA = C = Ctl
Gaub & Carlson (1997a)	RS: SNAP-IV (Unscr-CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	SNAP-IV, CBCL	ODD, delinquency & externalising School behaviour problems	H/I = C > IA > Ctl IA = H/I = C > Ctl
Graetz et al. (2001)	I: DISC-4 (Unscr-CP)	Parent	NC: 6-17 years, N=268, (B 188, G 80), Ctl: 3298, (B 1640, G 1658)	CBCL	Delinquency & aggression	C > H/I > IA > Ctl
Lahey et al. (1998)	I: DISC-2.3 (Scr-CP)	Teacher	C & NC: 4-6 years, N= 126, (B 102, G 24), Ctl: N=126, (B 108, G 18)	TASB	Aggression Disruption	IA = H/I = C = Ctl H/I = C > IA > Ctl
Lamminmaki et al. (1995)	RS: ACTeRS (Unscr-CP)	Teacher & parent	C: 7-11 years, N=67, (Gender ratios not given)	CBCL	Externalising	IA = H/I = C; C > Ctl
McBurnett et al. (1999)	RS: SNAP-R (Unscr-CP)	Teacher & Parent	C: 3-18 years, N=692, M=8.58, (B 78.5%, G 21.5%)	SNAP-R	T & P - ODD/problem behaviour T - Aggression	H/I > C > IA H/I = C > IA
Morgan et al. (1996)	RS: SNAP-1V (Scr-CP)	Teacher & parent	C: 6-12 years, N=56, (Gender ratios not given)	CBCL	P - Externalising, delinquency & aggression	C > IA
				TRF	T - Externalising, delinquency & aggression	IA = C
Nolan et al. (1999)	RS: CSI-4 (Scr-CP)	Teacher & parent	C: 3-18 years, N=148, (B 77%, G 23%)	IOWA-Conners, CSI-4	ODD/CD & aggression	C > IA
Nolan et al. (2001)	RS: CSI-4, ASI-4, ESI-4 (Unscr-CP)	Teacher	NC: 3-18 years, N=476, (B 348, G 128)	CSI-4, ASI-4, ESI-4	ODD/CD Aggression	C > H/I > IA > Ctl H/I = C > IA

Table 20, continued

Ostrander et al. (1998)	I: DICA-R-P (Scr-CP)	Parent	NC: 6-12 years, N=194, Ctl: N=107, (B 78%, G 22%)	BASC, CBCL	Aggression, conduct problems & delinquency	C > IA > Ctl
Paternite et al. (1996)	I: DICA-P (Modif) (Scr-CP)	Teacher & parent	C:, 6-12 years, N=96, (B only)	CBCL, Conners & direct observation	P - Delinquency & aggrression T - Delinquency T - Aggression	H/I = C > IA = Ctl C > IA = H/I = Ctl C > H/I > IA = Ctl
Teegarden & Burns (1999)	RS: CADBI-TRS-2 (Scr-CP)	Teacher	NC: 6th gr. N=41, (B 27, G =14), Ctl: N=39, (B 26, G 13)	CADBI-TRS-2	Stability of ODD & CD symptoms	H/I = C > IA = Ctl
Wheeler & Carlson (2000)	I: DSM-IV (Unscr-CP)	Teacher & parent	C & NC: 8-11 years, N=30, Ctl: 17, (Gender ratios not given)	SNAP, RBPC.	ODD, CD, & aggression	C > IA = Ctl
Willcutt et al. (1999)	RS: SNAP-IV (Scr-CP)	Teacher & parent	NC: 8-18 years, N=105, (B 72, G 33), Ctl: N=95, (B 65 G 30)	SNAP-IV	T & P - ODD & CD symptoms	C > IA = H/I > Ctl
Wolraich et al. (1996)	RS: SNAP (Modif) (Unscr-CP)	Teacher	NC: 6-12 years, N=7938, (B 4102, G 3836)	SNAP (modif), DBD scale	Conduct/behaviour problems	C = H/I > IA
<u>Neuropsychological</u>						
DSM-III						
Ackerman et al. (1982)	RS: IOWA Conners (modif) (Unscr-CP)	Clinician	C: Prim chn, N=43, (Gender ratios and age not given)	WISC-R, WRAT, MMFT, CEFT Colour naming test	Overall cognitive style & reaction time Omissions, colour naming	ADD = ADDH ADDH > ADD
Ackerman et al. (1983)	RS: IOWA Conners	Clinician	C: Prim chn, N= 79, (B 36, G 43) (Ages not	WISC-R, WRAT, MMFT, CEFT	Overall cognitive style & reaction time	ADD = ADDH

Table 20, continued

	(modif) (Unscr-CP)		given)	Colour naming, level-sharpening	Omissions	ADDH > ADD
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Clinician	C & NC: 6-11 years, N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	CPT	Omissions & commissions	ADDH > Ctl
					Off task behaviour	ADDH > ADD = Ctl
				MFFT	Task time & errors	ADD = ADDH
Barkley et al. (1992)	RS: DSM-III-R, CAP (Unscr-CP)	Clinician	C: Prim chn, N=24, Ctl: N=12, (Gender ratios and age not given)	CPT, COWAT, Stroop, WCST	Frontal lobe function	ADD = ADDH
Carlson et al. (1986)	RS: SNAP (Unscr-CP)	Clinician.	NC: Gr 2-5, N=35, (B 26, G 9) Ctl: N=16, (B 13, G 3)	Stroop, rapid naming task	Word, colour word	ADD = ADDH > Ctl
				Visual perception	Sustained visual attention.	ADD = ADDH
					Visual matching task	ADD < Ctl
Hynd et al. (1991)	RS: SNAP (Unscr-CP)	Clinician.	C: 9-15 years, N=20, (B 17, G 3)	Rapid & alternate naming test	Cognitive function	ADD < ADDH
DSM-IV						
Chhhabildas et al. (2001)	RS: DSM-IV	Clinician	C: Twins, 8-18 years, N=114, (B 68, G 46), Ctl: N=82, (B 47, G 35)	WISC-Coding	Errors	IA = C > H/I = Ctl
				Trailmaking	Total time	IA > H/I= CI = Ctl
				Gordon Inhibition	Commissions	IA = C > H/I > Ctl
				Gordon vigilance	Omissions	IA > H/I = C > Ctl
				Stop task	Inhibition	IA = C > Ctl
Houghton et al. (1999)	I: DSM-IV (Unscr-CP)	Clinician	C: 6-12 years, N=94, (B 55, G 39), Ctl: N=28, (B 15, G 13)	WCST	Perseveration	C < Ctl
					Total errors	IA = C > Ctl.
				Stroop	Word	IA < Ctl
					Colour word	C < Ctl
				MFFT	Literacy & errors	IA = C = Ctl
				Trail-making	Time & errors	IA = C = Ctl
				Tower of London	Planning	IA = C = Ctl

Table 20, continued

Klorman et al. (1999)	I: DISC-2.3 (Unscr-CP)	Clinician	C: 7-13 years, N= 117, (B 84, G 33), Ctl: N=28, (B 11, G 17)	Tower of Hanoi WCST	Problem solving Rule violation Overall errors Non-perseveration errors	C < IA = Ctl C > IA = Ctl IA = C = Ctl C > Ctl
Lockwood et al. (2001)	I: DSM-IV	Clinician.	C; 6-12 years, N=40 (B 20, G 20), Ctl=40, (B 20, G 20)	Story memory Trailmaking B Trailmaking B COWA COWA Shape cancellation WISC-Digit Span	Recognition Inhibition errors Off-task errors Rule violations Decrement Time Verbal fluency, comprehension & short-term memory	IA > C C > IA C > IA C > IA C > IA IA > C IA = C
Nigg (1999)	I: DISC-IV RS: SNAP (Unscr-CP)	Clinician.	C: Gr 1-6, M=9.75, N=25, (B 14, G 11), Ctl: N=25, (B 17, G 8)	Stop task	Response inhibition time	C > Ctl
Nigg et al. (2002)	RS: SNAP-IV (Unscr-CP)	Clinician	C: 7-12 years, N=64, (B 46, G 18), Ctl: N=41, (B 24, G 17)	Stop task Stroop Tower of London Trailmaking A Trailmaking B	Inhibition Reaction time Colour naming Word/colour word Planning Total time Total time	IA = C > Ctl IA = C > Ctl IA = C = Ctl IA = C = Ctl IA = C > Ctl IA > C = Ctl IA = C > Ctl
Paternite et al. (1996)	I: DICA-P (Modif) (Scr-CP)	Clinician.	C: 3-18 years, N=148, (B 77%, G 23%)	CPT MFFT	Omission errors Commission errors Total errors & response latency	IA = C > Ctl IA = C = Ctl IA = C = Ctl

Neurological

Table 20, continued

DSM-III						
Frank & Ben-Nun (1988)	I: DSM-III (Unscr-CP)	Clinician	C: 7-13 years, N=32, (B only)	Neurological exam ITPA	Pre & peri-natal problems Visual perception, sequencing & writing problems	ADD < ADDH ADD < ADDH
Holcomb et al. (1985)	RS: IOWA Conners (modif) (Unscr-CP)	Clinician	C: 8-12 years, N=66, RD=21, Ctl: N=24, (B only)	EEG	Midline electrodes P300 latency	ADD = ADDH > Ctl ADD = ADDH > Ctl
DSM-IV						
Clarke et al (1998)	I: DSM-IV	Clinician	C: 8-12 years, N=40, (B 32, G 8), Ctl: N=20, (B 16, G 4)	EEG	Relative/absolute alpha, beta, theta, delta	C > IA > Ctl
Clarke et al. (2001a)	I: DSM-IV	Clinician	C: 8-12 years, N=120, Ctl=40, (B 128, G 32)	EEG	Relative/absolute alpha, beta, theta, delta Right hemisphere Left hemisphere	C > IA > Ctl C > IA IA = C
Clarke et al. (2001b)	I: DSM-IV	Clinician	C: 8-12 years, N=160, Ctl=80, (B 120, G 120)	EEG	Relative/absolute alpha, beta, theta, delta	C > IA > Ctl
Johnstone et al. (2001)	I: DSM-IV	Clinician	C: 8-17 years, N=100, Ctl=50, (Gender ratios not given)	Event related potentials	N1 latency, amplitude, target stimuli P2 amplitude Commission errors, reaction time, & omission errors	C > IA C > IA IA = C

<u>Psychophysiological</u>

Table 20, continued

DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Scr-CP)	Clinician	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	Actometer	Wrist & ankle reading	ADD = ADDH
DSM-IV						
Dane et al. (2000)	I: DSM-IV RS: PICS, TTI (Unscr-CP)	Clinician	C: 7-12 years, N=64, (B 21, G 21), Ctl: N=22, (B14, G 8)	Actigraph	Overall actigraph AM scores PM scores	IA = C = Ctl IA = C = Ctl IA = C > Ctl
Paternite et al. (1996)	I: DICA-P (Scr-CP)	Clinician	C:, 6-12 years, N=96, (B only)	Actometer	Free play Classsroom time	IA = H/I = C = Ctl IA = H/I = C = Ctl
<u>Motor activity</u>						
DSM-III						
Barkley et al. (1992)	RS: DSM-III-R, CAP (Unscr-CP)	Clinician	C: Prim chn, N=24; Ctl: N=12, (Gender ratios and age not given)	Porteus mazes	Tracing/copying	ADDH = ADD
DSM-IV						
Lockwood et al. (2001)	I: DSM-IV	Clinician.	C; 6-12 years, N=40, (B 20, G 20), Ctl=40, (B 20, G 20)	ROCF	Complex figure deficits	IA > C
<u>IQ and academic functioning</u>						
DSM-III						

Table 20, continued

Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Scr-CP)	Clinician	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	WISC-R SSQ	FSIQ Special education & grade retention	ADD = ADDH < Ctl ADDH > ADD = Ctl
Berry et al. (1985)	I: DSM-III RS: Yale Ch. Inv. (Unscr-CP)	Clinician	C: 6-14 years, N=134, (B 102, G 32), Ctl: (B 62, G 32)	WISC-R	FSIQ, VIQ & PIQ	ADD = ADDH < Ctl
Carlson et al. (1986)	RS: SNAP (Unscr-CP)	Clinician	NC: Gr 2-5, N=35, (B 26, G 9), Ctl: N=16, (B 13, G 3)	WISC-R BASIS	FSIQ VIQ PIQ Maths Reading Spelling	ADD = Ctl > ADDH ADD > ADDH ADD = ADDH ADD < ADDH = Ctl ADD = ADDH < Ctl ADD = ADDH
Casey et al. (1996)	I: DSM-III RS: CAP (Unscr-CP)	Clinician	C: 6-11 years, N=84, (B 68, G 16)	WISC-R WRAT	FSIQ Reading, spelling & arithmetic	ADD = ADDH ADD = ADDH
Edelbrock et al. (1984)	RS: DSM-III (Unscr-CP)	Teacher	C: 6-11 years, N=25, Ctl: N=62 (B only)	Academic performance	Grade retention	ADD > ADDH = Ctl
Frank & Ben-Nun (1988)	I: DSM-III (Unscr-CP)	Clinician	C: 7-13 years, N=32, (B only)	WISC-R	FSIQ	ADD = ADDH
Hynd et al. (1991)	RS: SNAP, K-SADS (Unscr-CP)	Clinician & parent	C: 9-15 years, N=20, (B 17, G 3)	WISC-R BASIS	FSIQ, VIQ & PIQ P - Math, reading & spelling problems	ADD = ADDH ADD > ADDH
Lahey et al. (1987)	I: K-SADS RS: SNAP (Scr-CP)	Clinician	C: 6-13 years, N= 63, (B 80%, G 20 %)	Conners, RBPC	FSIQ	ADD = ADDH
Marshall et al. (1999)	RS: DSM-III (Unscr-CP)	Teacher	C: 8-12 years, N=40, (B 33, G 7)	Woodcock	Overall math & reading skills Math calculation	ADD = ADDH ADD < ADDH.

Table 20, continued

Stanford & Hynd (1994)	RS: DSM-III, SNAP (Unscr-CP)	Clinician	C: 5-16 years, N= 60, (B 43, G 17)	WISC-R	FSIQ	ADD = ADDH
DSM-IV						
Dane et al. (2000)	I: DSM-IV RS: PICS, TTI (Unscr-CP)	Clinician	C: 7-12 years, N=64, (B 21, G 21), Ctl: N=22, (B14, G 8)	WISC-III	FSIQ	IA = C < Ctl
Decker et al. (2001)	I: DSM-IV (Scr-CP)	Clinician	C: 3-18 years, N=287, (B 202, G 84, 1 subject not identified), Ctl: N=290, (B 182, G 108)	Woodcock	Comorbid LD's	IA = H/I
Faraone et al. (1998)	RS: SADSS-SCE (Modif) (Unscr-CP)	Clinician & teacher	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135 (B 104, G 31)	WISC-R WRAT	FSIQ Reading & arithmetic Academic tutoring Special education	IA = C < Ctl IA = H/I = C = Ctl IA = C > H/I = Ctl C > IA
Gaub & Carlson (1997a)	RS: SNAP-1V (Unscr CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	Academic performance	Learning Hard working	H/I = Ctl > IA = C Ctl > H/I > IA = C
Lahey et al. (1998)	I: DISC-2.3 (Unscr-CP)	Clinician, teacher & parent	C & NC: 4-6 years, N= 126, (B 102, G 24), Ctl: N=126, (B 108, G 18)	Stanford-Binet Woodcock-Johnson Parent report Academic performance	FSIQ T - Maths problems P - Reading problems Special education referral	H/I = Ctl > IA = C IA = C > H/I = Ctl IA > Ctl IA = H/I = C > Ctl
Lamminmaki et al. (1995)	RS: ACTeRS (Unscr-CP)	Clinician & teacher	C: 7-11 years, N=45, (B 26, G 19), Ctl: N=22, (B 11, G 11)	WISC-R Woodcock	FSIQ, VIQ & PIQ T- Reading problems	IA = H/I = C = Ctl IA = H/I = C = Ctl
McBurnett et al. (1999)	RS: SNAP-R (Unscr-CP)	Teacher	C: 3-18 years, N=692, M=8.58, (B 78.5%, G 21.5%)	TRF	Academic learning & performance Working hard	HI > IA = C H/I > C > IA

Table 20, continued

Morgan et al. (1996)	RS: SNAP-IV (Unscr-CP)	Clinician & teacher	C: 6-12 years, N=56, (Gender ratios not given)	WISC-III BASIS	FSIQ, VIQ & PIQ T - Reading, maths & spelling T - Maths LD T - Reading LD	IA = C IA = C IA > C IA = C
Nolan et al. (2001)	RS: CSI-4, ASI-4, ESI-4 (Unscr-CP)	Teacher	NC: 3-18 years, N=476, (B 348, G 128)	Academic performance	Special education referral	IA = C > Ctl > H/I
Paternite et al. (1996)	I: DICA-P (Modif) (Scr-CP)	Clinician	C: 3-18 years, N=148, (B 77%, G 23%)	WRAT	Reading, spelling & arithmetic FSIQ, VIQ & PIQ	IA = H/I = C = Ctl IA = H/I = C = Ctl
Vaughn et al. (1997)	RS: SNAP (Unscr-CP)	Clinician	C: 6-11 years, N=35, Ctl: N=38, (Gender ratios not given)	WISC-III WRAT	FSIQ Reading, spelling & arithmetic	C = Ctl > IA IA = C = Ctl
Wheeler & Carlson (2000)	I: DSM-IV (Unscr-CP)	Clinician	C & NC: 8-11years, N=30, Ctl: 17, (Gender ratios not given)	WISC-III	FSIQ Reading, spelling & maths problems	IA = C = Ctl IA = C = Ctl
Willcutt et al. (1999)	RS: SNAP-IV (Scr-CP)	Clinician	NC: 8-18 years, N=105, (B 72, G 33), Ctl: N=95, (B 65 G 30)	WISC-R, WAIS	FSIQ	IA = C < H/I = Ctl

Internalising behaviour

a) Anxiety

DSM-III

Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Teacher & parent	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	CBCL	P - Anxiety T - Anxiety	ADD = ADDH > Ctl ADD = ADDH = Ctl

Table 20, continued

Cantwell & Baker (1992)	I: DICA RS: DSM-III (Unscr-CP)	Teacher & parent	C: 4-14 years, N=80, (B50, G 30)	CBCL, Conners, Rutter Scales	T & P - Anxiety	ADD = ADDH
Lahey et al. (1984)	RS: RBPC (Unscr-CP)	Teacher	NC: Gr 2-5, N=30, (B 22, G 8) Ctl: N=20, (B 14, G 6)	RBPC	Anxiety	ADD > ADDH
Lahey et al. (1987)	I: K-SADS RS: SNAP (Scr-CP)	Teacher & parent	C: 6-13 years, N= 63, (B 80%, G 20 %) C: 6-13 years, Study A (Unscr) N= 63, (B 80%, G 20 %) Study B (Scr) N=32, (B 80%, G 20 %)	Conners, RBPC	Study A: Anxiety Study B: Anxiety	ADD = ADDH ADD > ADDH
DSM-IV						
Crystal et al. (2001)	I: DICA-R-P (Unscr-CP)	Child	NC: 6-11 years; N=309, Ctl: N=144, (B 79%, G 21%)	BASC RCMAS	Anxiety Physical anxiety Concentration anxiety	IA = C > Ctl C > Ctl; IA = Ctl IA = C > Ctl
Eiraldi et al. (1997)	I: DICA-R-P (Scr-CP)	Teacher & parent	C: 6-12 years, N=53, Ctl: N=33, (Gender ratios not given)	DSMD, ADDES	Anxiety	IA = C > Ctl
Faraone et al. (1998)	RS: SADSS–SCE (Modif) (Unscr-CP)	Parent	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135, (B 104, G 31)	CBCL	Anxiety	IA = H/I = C > Ctl
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	CBCL	Anxiety	IA > Ctl
Gaub & Carlson (1997a)	RS: SNAP-1V (Unscr CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	SNAP-IV, CBCL	Anxiety	C > IA = H/I > Ctl

Table 20, continued

Morgan et al. (1996)	RS: SNAP-4 (Scr-CP)	Teacher & parent	C: 6-12 years, N=56, (Gender ratios not given)	CBCL	Anxiety	IA = C
Nolan et al. (2001)	RS: CSI-4, ASI-4, ESI-4 (Unscr-CP)	Teacher	NC: 3-18 years, N=476, (B 348, G 128)	CSI-4, ASI-4, ESI-4	Anxiety - Preschool boys Anxiety - Primary school boys Anxiety - Secondary school boys	C > IA = H/I > Ctl C > IA = H/I > Ctl C > H/I > IA > Ctl
Ostrander et al. (1998)	I: DICA-R-P Unscr-CP)	Parent	NC: 6-12 years, N=194, (B 159, G 35), Ctl: N=107, (B 77, G 30)	BASC CBCL	Anxiety Anxiety	IA = C > Ctl C > IA > Ctl
Vaughn et al. (1997)	RS: SNAP (Unscr-CP)	Teacher & parent	C: 6-11 years, N=54, Ctl: N=19. Gender ratios not given	BASC CBCL	T - Anxiety P - Anxiety	IA = C = Ctl IA = C > Ctl
Wheeler & Carlson (2000)	I: DSM-IV (Unscr-CP)	Teacher & parent	C & NC: 8-11 years, N=30, Ctl: 17, (Gender ratios not given)	RBPC	Anxiety	IA = C > Ctl
Willcutt et al. (1999)	RS: SNAP-IV (Scr-CP)	Parent & child	NC: 8-18 years, N=105, (B 72, G 33), Ctl: N=95, (B 65 G 30)	DICA	Anxiety	IA= C = Ctl
b) Depression						
DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Teacher & parent	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	CBCL	P - Depression	ADDH > ADD; ADDH > Ctl
Cantwell & Baker (1992)	I: DICA RS: DSM-III	Teacher & parent	C: 4-14 years, N=80, (B50, G 30)	Interview Conners, Rutter	P - Depression T & P - Depression	ADD > ADDH ADD = ADDH

Table 20, continued

	(Unscr-CP)			Scales		
Lahey et al. (1987)	I: K-SADS RS: SNAP (Scr-CP)	Teacher & parent	C: 6-13 years, N= 63, (B 80%, G 20 %) C: 6-13 years, Study A (Unscr) N= 63, (B 80%, G 20 %) Study B (Scr) N=32 (B 80%, G 20 %)	Conners, RBPC	Study A: P & Ch - Depression Study B: P - Depression Ch- Depression	ADD = ADDH ADD > ADDH ADD = ADDH
DSM-IV						
Crystal et al. (2001)	I: DICA-R-P (Unscr-CP)	Parent & child	NC: 6-11 years; N=309, Ctl: N=144, (B 79%, G 21%)	BASC CDI	P- Depression. Ch - Depression. Ch - Depression	C > IA > Ctl IA = C > Ctl IA = C > Ctl
Eiraldi et al. (1997)	I: DICA-R-P (Scr-CP)	Teacher & parent	C: 6-12 years, N=53, Ctl: N=33, (Gender ratios not given)	DSMD	Depression	IA = C > Ctl
Faraone et al. (1998)	RS: SADSS–SCE (Modif) (Unscr-CP)	Parent & clinician	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135, (B 104, G 31)	CBCL	Depression	C > IA; IA = H/I > Ctl
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	CBCL	Depression	IA > Ctl
Gaub & Carlson (1997a)	RS: SNAP-1V (Unscr CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	SNAP-IV, CBCL	Depression	C > H/I = IA > Ctl
Morgan et al. (1996)	RS: SNAP-4 (Scr-CP)	Teacher & parent	C: 6-12 years, N=56, (Gender ratios not given)	CBCL	Depression	ADHD-IA = C
Nolan et al. (2001)	RS: CSI-4, ASI-4, ESI-4 (Unscr-CP)	Teacher	NC: 3-18 years, N=476, (B 348, G 128)	CSI-4, ASI-4, ESI-4	Depression - Preschool boys Depression - Primary school boys	H/I = C > IA = Ctl IA = C > H/I > Ctl

					Depression - Secondary school boys	C > IA = H/I > Ctl
Ostrander et al. (1998)	I: DICA-R-P (Unscr-CP)	Parent	NC: 6-12 years, N=194, Ctl: N=107, (B 77, G 30)	BASC, CBCL	Depression	C > IA > Ctl
Vaughn et al. (1997)	RS: SNAP (Unscr-CP)	Teacher & parent	C: 6-11 years, N=54, Ctl: N=19. Gender ratios not given	BASC CBCL	T - Depression P - Depression	IA = C = Ctl IA = C > Ctl
Willcutt et al. (1999)	RS: SNAP-IV (Scr-CP)	Parent & child	NC: 8-18 years, N= 105, (B 72, G 33), Ctl: N=95, (B 65 G 30)	SNAP-IV-P DICA-Child	P -Depression Ch - Depression	IA = C > H/I = Ctl IA > H/I = C = Ctl
c) Other internalising problems						
DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Teacher & parent	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	CBCL	T - Withdrawal P - Somatic & withdrawal	ADD = ADDH > Ctl ADD = ADDH
Cantwell & Baker (1992)	I: DICA RS: DSM-III (Unscr-CP)	Teacher, parent & child	C: 4-14 years, N=80, (B50, G 30)	CBCL, Conners, Rutter Scales	Withdrawal	ADD = ADDH
Lahey et al. (1984)	RS: RBPC (Unscr-CP)	Teacher	NC: Gr 2-5, N=30, (B 22, G 8) Ctl: N=20; (B 14, G 6)	RBPC	Withdrawal	ADD > ADDH
DSM-IV						
Eiraldi et al. (1997)	I: DICA-R-P (Scr-CP)	Teacher & parent	C: 6-12 years, N=53, Ctl: N=33, (Gender ratios not	DSMD, ADDES.	T - Internalising P - Internalising	IA = C > Ctl C > IA > Ctl

			given)			
Faraone et al. (1998)	RS: SADSS–SCE (Modif) (Unscr-CP)	Parent	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135, (B 104, G 31)	CBCL	Withdrawal Somatic problems	IA = H/I = C > Ctl IA = C > Ctl
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	CBCL	Withdrawal Somatic problems	IA > H/I = C = Ctl IA = H/I = C = Ctl
Gaub & Carlson (1997a)	RS: SNAP-IV (Unscr-CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	CBCL	Somatic problems Withdrawal	C > H/I = Ctl IA = C > HI = Ctl
Morgan et al. (1996)	RS: SNAP-4 (Scr-CP)	Teacher & parent	C: 6-12 years, N=56, (Gender ratios not given)	CBCL	ithdrawal & somatic problems	IA > C
Ostrander et al. (1998)	I: DICA-R-P (Unscr-CP)	Parent	NC: 6-12 years, N=194, Ctl: N=107, (B 77, G 30)	BASC CBCL	Withdrawal Withdrawal & somatic problems	IA = C > Ctl IA = C > Ctl
Vaughn et al. (1997)	RS: SNAP (Unscr-CP)	Teacher & parent	C: Age range 6-11, N=54, Ctl: N=19, (Gender ratios not given)	BASC	T- Internalising	IA = C = Ctl
Wheeler & Carlson (2000)	I: DSM-IV (Unscr-CP)	Teacher, parent & child	C & NC: 8-11years, N=30, Ctl: 17, (Gender ratios not given)	RBPC	Withdrawal	IA = C > Ctl
<u>Family functioning</u>						
DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Teacher & parent	C & NC: 6-11 years, N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G 1)	HSQ	P -Problem severity P -Problem pervasiveness Family therapy	ADDH = ADD = Ctl ADDH > ADD > Ctl ADDH > ADD; ADD >

						Ctl
Lewis (1992)	RS: CPRS-48 (Unscr-CP)	Parent	C: 6-11 years, N=65, (B only)	FACES-III	Family functioning & cohesion	ADD > ADDH
DSM-IV						
Faraone et al. (1998)	RS: SADSS–SCE (Unscr-CP)	Parent	C: 8-12 years, N=302, (B 231, G 71), Ctl: N=135, (B 104, G 31)	FES	Family functioning	IA = H/I = C = Ctl
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	Parental Behaviour Inventory	Mother-child interactions	IA = H/I = C = Ctl
Graetz et al. (2001)	I: DISC-4 (Unscr-CP)	Parent	NC: 6-17 years, N=268, (B 188, G 80), Ctl: (B 1640, G 1658)	DISC-IV CHQ	Family problems Positive family activities Family cohesion	IA = H/I = C = Ctl Ctl > IA = H/I > C Ctl > IA = H/I = C
Paternite et al. (1996)	I: DICA-P (Scr-CP)	Parent	C: N=96; 6-12 years, (B only)	FES	System maintenance Cohesion Conflict	IA = H/I = C = Ctl C < Ctl C > Ctl
Parent mental health						
DSM-IV						
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	SCL-90-R	Maternal total score Maternal depression Maternal alcohol use Maternal aggression	HI > IA = C = Ctl IA = H/I = C = Ctl C > Ctl IA = H/I = C; C > Ctl

Table 20, continued

<u>Peer relations</u>						
DSM-III						
Barkley, DuPaul, et al. (1990)	I: DSM-III-R (Unscr-CP)	Teacher	C & NC: 6-11 years N=90, M=8.65 (B 82, G 8), Ctl: N=36, M=8.80 (B 35, G1)	School Situations, TOPS	Peer problems School problems & social expectations.	ADDH > ADD = Ctl; ADD > Ctl ADD = ADDH < Ctl
Berry et al. (1985)	RS: Yale Child Inventory (Unscr-CP)	Teacher	C: 6-14 years, N=134, (B 102, G 32), Ctl: (B 62, G 32)	Yale Child Inventory	Peer rejection	ADDH > ADD = Ctl
Carlson et al. (1987)	RS: K-SADS, SNAP, RBPC (Scr-CP)	Teacher	C: 6-13 years, N=56; Ctl: N=45, (Gender ratios not given)	RBPC	Peer likes most (Unscr) Peer likes least (Unscr) Peer likes most (Scr) Peer likes least (Scr)	ADD = ADDH < Ctl ADDH > ADD = Ctl ADD = ADDH < Ctl ADD = ADDH > Ctl ADD = ADDH > Ctl
King & Young (1982)	RS: DSM-III, SNAP (Unscr-CP)	Child and peer	NC: Gr 2-4, N=31; Ctl: N=27, (Gender ratios not given)	PPSC	Peer - like Peer - dislike Ch – self-rated "liked" Ch – self-rated "smart"	ADD = ADDH < Ctl ADD = ADDH > Ctl ADDH > ADD; ADDH = Ctl ADDH > ADD; ADD = Ctl
DSM-IV						
Gadow et al. (2000)	RS: CSI-4 (Unscr-CP)	Parent	NC: 10-12 years, N=743, (Gender ratios not given)	CSI-4	Peer problems	ADHD-IA > Ctl
Gaub & Carlson (1997a)	RS: SNAP-IV (Unscr-CP)	Teacher	NC: M=7.6, N=221, Ctl: N=221, (Gender ratios not given)	TRF	Peer like Peer dislike	Ctl > IA = H/I = C Ctl > IA = H/I = C
Graetz et al. (2001)	I: DISC-4 (Unscr-CP)	Parent	NC: 6-17 years, N=268, (B 188, G 80), Ctl: 3298, (B 1640, G 1658)	DISC-IV	Peer problems	C > IA = H/I

Table 20, continued

Lahey et al. (1998)	I: DISC-2.3 (Unscr-CP)	Teacher	C & NC: 4-6 years, N= 126, (B 102, G24), Ctl: N=126, (B 108, G 18)	TASB	Peer like Peer dislike Social cooperation	Ctl > H/I > C = IA Ctl < IA = H/I < C Ctl > H/I > IA = C
McBurnett et al. (1999)	RS: SNAP-R (Unscr-CP)	Teacher & parent	C: 3-18 years, N=692, M=8.58, (B 78.5%, G 21.5%)	SNAP-R	Peer dislike Peer annoyance	IA = H/I > C H/I = C > IA
Nolan et al. (2001)	RS: CSI-4, ASI-4, ESI-4 (Scr-CP)	Teacher	NC: 3-18 years, N=476, (B 348, G 128)	CSI-4, ASI-4 ESI-4	Social problems	C > IA = H/I
Wheeler & Carlson (2000)	I: DSM-IV (Unscr-CP)	Teacher & parent	C & NC: 8-11 years, N=30, Ctl: 17, (Gender ratios not given)	CABS	T & P- like & social preference P-dislike T-dislike T & P-amount ignored T-social performance P-social performance	IA = Ctl > C C > IA = Ctl C > Ctl C > Ctl C > Ctl IA = Ctl > C

Note: * = unscreened for conduct problems, ** = screened for conduct problems; • C = clinical group, NC = non clinical group, Ctl = control group; B = boys, G = girls. * T = teacher, P = parent, Ch = child. # Based on DSM-III diagnostic criteria, ADD = attention deficit disorder without hyperactivity, ADDH = attention deficit disorder with hyperactivity. Based on DSM-IV diagnostic criteria, IA = inattention subtype, H/I = hyperactive-impulsive subtype, C = combined inattention and hyperactive-impulsive subtype.

5 . 3 . 7 Parent mental health

5 . 3 . 7 . 1 Studies based on DSM-III diagnostic criteria

No DSM-III study was found that examined parent-mental health.

5 . 3 . 7 . 2 Studies based on DSM-IV diagnostic criteria

One study reported that the H/I subtype had more overall maternal self-report mental health problems than the C and IA subtypes, but no differences were found for maternal self-reported depression or aggression (Gadow et al., 2000). Also the C subtype had more alcohol abuse problems than controls. Although there were no subtype differences for alcohol use, mothers of the C subtype had higher alcohol use than either mothers of the IA, or H/I subtypes. This study did not screen for conduct problems.

5 . 3 . 7 . 3 Summary and integration of findings based on DSM-IV

The evidence from the single study suggests that it is the dimension of childhood hyperactivity-impulsivity, either separately or in conjunction with inattention, that contributes to parents of H/I and C children having more mental health problems than parents of IA children.

5 . 3 . 8 Peer relations

5 . 3 . 8 . 1 Studies based on DSM-III diagnostic criteria

In general, as shown by Table 20, the results of studies in this area have produced mixed findings. A few studies found no differences between the ADD subtypes

(Carlson et al., 1987; King & Young, 1982). Other studies have shown ADDH children to have more peer relationship difficulties than ADD children (Barkley et al., 1990, Berry et al., 1985). Interestingly, in the King and Young study, ADDH children rather than ADD children rated themselves as more "liked" and "smart". Without screening for conduct problems, Carlson et al. (1987) found the ADDH children to be less popular with peers than ADD children, but when screened for conduct problems these differences were no longer apparent. The existing data also show more peer-related difficulties among both ADD and ADDH children compared to control children (Barkley, DuPaul, et al., 1990; King & Young, 1982). Taken together, these findings suggested that ADDH children have more peer-related problems than ADD children. When conduct problems are screened such differences are likely to be minimised.

5.3.8.2 Studies based on DSM-IV diagnostic criteria

In general, as shown in Table 20, the results of studies in this area have suggested the C subtype to have more peer-related problems than the IA subtype (Graetz et al., 2001; Gaub & Carlson, 1997a; Nolan et al., 2001). Studies have also shown no differences between the C and H/I subtypes (McBurnett et al., 1999) or no differences between the IA and H/I subtypes (Nolan et al., 2001). The only study that adjusted for the effects of conduct problems reported the H/I subtype to have fewer peer-related problems than the IA and C subtypes (Lahey et al., 1998). Existing data also shows the ADHD subtypes to have more peer-related difficulties than control children. Taken together, these findings suggested that C children will have more peer-related problems than IA children, and H/I children and normal controls will have the fewest peer-related problems. When conduct problems are screened the effect is maintained indicating that it is either the combination of inattention and hyperactivity-impulsivity, or inattention alone, that is associated with peer-related problems rather than purely hyperactivity-impulsivity.

5 . 3 . 8 . 3 Summary and integration of findings based on DSM-III and DSM-IV diagnostic criteria

Findings based on DSM-III criteria for ADD generally show that ADDH children have more peer relationship difficulties than ADD children. As well, there is support for ADD children having greater problems in these areas than normal controls.

The DSM-IV studies provided some support for the C subtype having more peer relationship difficulties than the IA and H/I subtypes. The H/I subtype appeared to have least peer-related difficulties of the three subtypes. Findings also indicated the ADHD subtypes to have more peer-related problems than control children, but there were fewer distinctions between H/I and control children, or between IA and control children. Such results suggested that it is either inattention augmented by hyperactivity-impulsivity, or inattention by itself, which predisposes IA and C children to greater risk for peer relationship difficulties than H/I children. That the C subtype, both with/without controlling for conduct problems, had the most peer-related problems further emphasises the role of inattention in association with hyperactivity-impulsivity in the development of poor peer-related social skills.

5.3.9 Overall summary and integration of findings for differences between subtypes based on DSM-III and DSM-IV diagnostic criteria

Table 21, provides a summary of the differences between the subtypes. It is clear that the behaviours most able to reliably differentiate the ADD and ADHD subtypes are those behaviours associated with elevations in hyperactivity-impulsivity symptoms, such as aggression, delinquency and other similar externalising actions.

Table 21

Summary of Differences Among DSM-IV ADHD Subtypes, and Differences Between ADHD Subtypes and Control Children

Variable	Differences
ODD/CD, aggression, and externalising behaviours	H/I = C > IA > Ctl
Neurocognitive problems	IA = C > Ctl
IQ	H/I > IA = C; H/I = Ctl
Academic functioning problems	IA = C > H/I = Ctl
Internalising behaviours	IA = C > H/I > Ctl
Family functioning problems	C > H/I > IA > Ctl
Peer relation problems	C > IA = H/I = Ctl

Note: ODD/CD = oppositional/conduct problems; IA = inattention; H/I = hyperactivity-impulsivity; C = inattention and hyperactivity-impulsivity; Ctl = Control group

The evidence from both DSM-III and DSM-IV studies, uniformly indicates that children with the core symptoms of hyperactivity-impulsivity (i.e., ADDH, and H/I and C subtypes, respectively), have more aggression, delinquency, home and school behaviour problems, incidence of ODD and CD symptoms, and peer-related problems than children with the core symptoms of inattention (i.e., ADD, and IA subtypes respectively). While the effect of screening for conduct problems was to reduce the level of externalising problems in the three DSM-IV subtypes, it remained that the C subtype was more likely to have a comorbid secondary ODD/CD disorder than the IA subtype.

By contrast, the evidence for the other external correlates is less conclusive and more difficult to interpret. For instance, both DSM-III and DSM-IV studies of neuropsychological, neurological, psychophysiological, and motor activity, indicate few consistent distinctions between different subtypes of ADD or ADHD children except that there may be some qualitative subtype differences possibly related to regional brain function, and neuroanatomical structure, and specific age, gender, and maturational effects. Moreover, given that for DSM-IV so few subtype studies have investigated the independent effect of hyperactivity-impulsivity (as distinct from inattention), it seems that most studies were not able to control for the common effect of the core symptoms of inattention when comparing the IA and C subtypes. Thus it is hardly surprising that distinctions between the IA and C subtypes have been relatively non-systematic and may indicate difficulties in design and methodology (including sample type and measures used) rather than specific differences in neuropsychological, neurological, psychophysiological, and motor function between hyperactive-impulsive and inattentive ADHD children.

It also may be, as suggested by Barkley (1997), that differences between the IA and C subtypes are related to the fact that purely inattentive children have a different disorder than children with both hyperactivity-impulsivity and inattention. Thus, given that the central deficit among the DSM-IV subtypes appears to be related to attention processes, and the increasing findings of only subtle and qualitative differences between the two inattentive subtypes, it is hardly surprising that no clear distinctions between the IA and C subtypes have emerged in the literature.

A similar pattern prevailed to the areas of IQ and learning with both DSM-III and DSM-IV studies indicating few subtype differences for IQ and core learning areas. However, the DSM-IV studies to a limited degree were able to differentiate the IA and C subtypes for aspects of core learning specific to spelling and maths, as there was some evidence that IA children with the core symptom of inattention had more spelling and maths problems than C children with the combined symptoms of inattention and hyperactivity-impulsivity. Given that after controlling for conduct problems IA children had a greater maths-related disability than C children it is suggested that learning problems related to core learning areas such as maths may be specific markers defining differences in cognitive functioning between ADHD subtypes. In addition, that H/I children had higher IQ and fewer overall learning problems than the C subtype, further suggests that it is the component of inattention, rather than hyperactivity-impulsivity within the C subtype that is more responsible for cognitive learning problems.

The area of anxiety/depression, and other internalising behaviours also produced a pattern of results that are extremely difficult to interpret. Few consistent systematic differences were found between the subtypes in both DSM-III and DSM-IV studies. There was some evidence in DSM-IV studies to suggest that the C subtype had marginally more anxiety/depression and other internalising problems than the IA subtype, but the H/I subtype had fewer overall internalising problems than both the IA and C subtypes. That the C subtype had slightly more anxiety/depression than the IA subtype initially implicates hyperactivity-impulsivity in association with inattention, rather than inattention alone, as a greater risk factor for internalising behaviours.

However that H/I children had fewer anxiety/depression problems than either the IA or C children to some degree counteracts the preceding proposition. In addition, the few studies controlling for the effects of conduct problems were unable to find systematic differences between the subtypes with inattention (i.e., IA and C subtypes) for anxiety, depression, and other internalising problems. Overall, the evidence for internalising behaviours suggests that the IA and C subtypes have more internalising problems than the H/I subtype. There is insufficient evidence to differentiate the subtypes with inattention, rather it appears that inattention is the key component that either independently, or additively and/or interactively leads to internalising problems.

The evidence for peer relations produced a pattern of results showing children with inattention, either separately or in association with hyperactivity-impulsivity, rather than hyperactivity-impulsivity per se, had marginally increased risk for problematic peer relations. By contrast, the limited evidence pertaining to family functioning, and parent mental health provided insufficient evidence to reliably discern systematic subtype differences, although there was some support for the C subtype having marginally more family functioning problems and associated parent psychopathology than IA and H/I children.

Comparisons between the different DSM-III and DSM-IV subtypes, and control children revealed that most distinctions occurred in areas associated with "acting out", aggressive, externalising or socially disruptive behaviours. There were clear distinctions, with children with the core symptoms of hyperactivity-impulsivity (i.e., ADDH, or C or H/I subtypes respectively), rather than the core symptoms of inattention (i.e., ADD, or IA subtypes respectively), differing more from control children.

In summary, most studies showed that behaviours associated with aggression and externalising behaviours (i.e., ODD/CD, school and home behaviour problems, peer interaction difficulties) were able to more reliably differentiate between subtypes. Hyperactivity-impulsivity, and especially hyperactivity-impulsivity in association with inattention, rather than inattention per se, was almost uniformly related to increased scores for aggressive and externalising behaviours at home and at school. However most studies did not screen for comorbidity with ODD/CD. After screening for conduct problems the association between hyperactivity-impulsivity per se, and aggression and other externalising behaviours was considerably reduced. Several authors have implied that neither hyperactivity-impulsivity (ie., H/I subtype), nor inattention (ie., IA subtype), as separate core ADHD symptoms, is associated with conduct problems, rather it is the combination of these core symptoms (ie., C subtype) in association with external contingencies such as problematic parent-child relations that is more likely to lead to a greater predisposition to develop conduct problems.

The subtypes did not consistently differ for IQ, however both subtypes with inattention (i.e., IA and C subtypes) had more academic functioning problems than the subtype with hyperactivity-impulsivity (i.e., H/I subtype). That, for maths and spelling the IA subtype had more problems than the C subtype suggests that there may be specific differences in cognitive functioning between the two subtypes with attention disorders. Finally, despite the lack of subtype differences in several studies for internalising behaviours, there is evidence to suggest that inattention, either separately, or in association with hyperactivity-impulsivity, is more associated with depression and anxiety than hyperactivity-impulsivity per se.

5 . 4 Part 2: Variables not yet examined as ADHD subtypes

As previously noted, Part 1 provided a comprehensive review of the findings, based on DSM-III and DSM-IV, pertaining to a broad range of the correlates for the different subtypes of ADHD children. Part 2 will consider those variables to be examined in this study that hitherto have not been examined as subtypes. These include social cognitions, parenting style, and aggression style. It is envisaged that an examination of these variables may provide a clearer understanding of how the different ADHD subtypes in DSM-IV differ from each other.

5.4.1 Social cognition

As indicated by Gomez and Gomez (2000), and Gomez, Gomez, DeMello, and Tallent (2001), numerous studies have shown that aggressive children have a higher tendency than non-aggressive children to attribute hostile intent to peers and to select hostile responses in conflict situations where the intentions of the perpetrators were ambiguous and/or threatening (Dodge, 1980; Dodge & Coie, 1987; Dodge & Frame, 1982; Quiggle, Garber, Panak, & Dodge, 1992). Indeed Crick and Dodge's (1994) review of social cognitions in aggressive children concluded that there is now strong evidence that childhood aggression is causally linked to hostile biased social cognitions. Many recent studies of the association between children's social cognition and aggression have been based on Dodge's (1986) social information processing (SIP) model. According to the latest version of this model (Crick & Dodge, 1994) a child's behavioural response in a social situation follows a set of SIP steps. These steps include; encoding of cues, interpretation of cues, clarification of goals, response access or construction, response decision, and behavioural enactment. Crick and Dodge (1994) have indicated that the different steps occur simultaneously (i.e., parallel processing rather than sequential processing), with feed back loops between the different steps. Within such a model, a child's social cognitions are differentially influenced by past social situations, especially those in early childhood related to attachment with principal caregivers, and parent/family and child interactions. Thus competent SIP will usually result in adaptive social behaviour, whereas hostile-biased, inaccurate, or ineffective processing will usually lead to more problematic behaviour (e.g., antisocial/aggressive behaviour).

Within the reformulated model, the role of emotion was also proposed an integral part of each SIP step. Other theorists have defined emotion as distinct from SIP (Gottman, 1986; Zajonc, 1980). Lemerise and Arsenio (2000) have suggested that emotion is about motivation, and cognition about knowledge, and have pointed to recent neurophysiological evidence (LeDoux, 1995) showing how emotional processes and cognitive processes influence each other, and make it difficult to isolate one from the other. Lemerise and Arsenio (2000), broadly supporting the SIP model of Crick and Dodge (1994), have hypothesised that while emotionality and emotional regulation skills may be separate from the knowledge structures that underpin social cognitions, they nevertheless are parallel processes that independently influence social cognitions and decision making. With respect to children with problem behaviours such as ADHD children, they have hypothesised that emotional regulation will have a greater effect on children who are high in emotionality and poor in regulation abilities.

Whalen, Henker, Collins, McAuliffe, and Vaux (1979) found that children, with a diagnosis approximating the DSM-III ADDH subtype, had deficits which prevented them from generating the appropriate social scripts, especially in peer interaction situations, or situations involving social problem solving. Generally, supportive of these findings, Grenell, Glass, and Katz (1987) later found that ADDH children, as compared with controls, had social information processing deficits, and their social responses were characterised by inappropriate, ineffective, less relationship enhancing, and impulsive behaviours. However no attempt was made to control for level of aggression in either of the above studies.

Milich and Dodge (1984) compared the hostile biased cognitions of hyperactive-aggressive, pure hyperactive, pure aggressive children, and controls. With respect to possible associations between social cognitions and ADHD, the hyperactive-aggressive group and the purely aggressive group were found to be more hostile in response decision, attribution and cue utilisation compared to the purely hyperactive group and controls.

Another study that examined links between SIP and ADHD has shown the critical mediating role of aggression within the association between SIP and ADHD (Coy, Spelz, DeKlyen, & Jones, 2001). This study found that boys diagnosed with either ADHD-ODD or ODD, assessed three times over a two-year period, were equal in their attributions, and twice as likely to generate aggressive solutions than ADHD only and control comparison boys. The association of hostile-biased attribution and response selection was examined among aggressive boys (Gomez & Gomez, 2000), clinic-referred aggressive children (Gomez et al., 2001), and children with a diagnosis of ADHD (Gomez & Gomez, 2003). Results showed that aggression, but not hyperactivity was associated with hostile-biased social cognitions. Taken together, these studies appear to suggest that when the effects of ODD/CD are controlled, ADHD children do not have a tendency for hostile biased social cognitions.

However, Amin, Douglas, Mendelson, and Dufresne (1993), based on a long series of neuropsychological studies, hypothesised that the poor impulse control of ADDH children can lead to social information processing deficits. Indeed, Dodge and Frame (1982) noted that, to some degree, the difference in social cognitions might be due to a general inhibitory response deficit, or impulsivity.

To date, no studies have specifically examined emotionality within the context of social cognitions, or the SIP model. Given the perceived influence of impulsivity upon the social cognitions of the H/I and C subtypes, it is suggested that the impulsivity and reactivity within the H/I and C subtypes will be reflected as high emotionality and poor emotional regulation (Lemerise & Arsenio, 2000). Thus, given that the H/I and C subtypes major problems appear related to poor impulse control, this argument implies that children with these disorders are at risk for hostile-biased social cognitions and greater emotionality and poor emotional regulation compared to IA children and normal controls. As IA children do not have a response inhibitory deficit it can be speculated that children with a purely inattention disorder may not have hostile-biased social cognitions or emotional regulation problems, and their social cognitions and emotional regulation will be similar to normal control children. As to date no study has examined these possibilities, given that this study is based on DSM-IV clinical data, it is expected that this study will provide further clarification of these issues.

5.4.2 Aggression style

Theoretical perspectives on aggression and antisocial behaviour suggest that, topographically and functionally, distinct subtypes of aggression exist (see Dodge, 1990; Hartup, 1974; Rule, 1974). Theories of aggressive behaviour (Bandura, 1973; Berkowitz, 1963) and ethological observations in animals (Lorenz, 1966) and children (Price & Dodge, 1989) suggest the existence of distinct forms of reactive (hostile) and proactive (instrumental) aggression. Reactive aggression is regarded as "hot-blooded" behaviour that is motivated by underlying states of anger and frustration (Price & Dodge, 1989). By contrast, proactive aggression has its foundation in social learning theory models (Bandura, 1973). Proactive aggression is acquired and maintained through positive environmental contingencies, and unlike reactive aggression, is not based in anger or retaliation.

Because reactive aggression is perceived to be contingent on perception of threat, the primary social cognitive mechanisms underlying it are postulated to involve encoding and interpretation of cues (Dodge, 1990). Thus, inappropriate displays of reactive aggression have been presumed to be associated with difficulties in intention-cue interpretation manifested as hostile attributional and response selection biases (Dodge & Coie, 1987; Hubbard, Dodge, Cilleson, Coie, & Schwartz, 2001; Schwartz et al, 1998). Dodge and Coie (1987) showed a critical distinction between reactive and proactive aggression, in that reactive aggression was associated with hostile attributional bias, when interpreting peer intention, whereas proactive aggression was not. A further type of aggression style, covert aggression, based on Dodge and Coie's (1987) dual aggression model (hostile proactive, vs. indirect covert aggression) has also been proposed. While covert aggression is related to proactive aggression because both types of aggression are instrumental in form, as opposed to proactive aggression that is overt, direct, and hostile in form, covert aggression is indirect, sneaky, and related to harm avoidance because the identity of the aggressor is either unknown or ambiguous (Schnake, Ruscher, Gratz, & O'Neal, 1997; Tomada & Schneider, 1997).

To date, only one study has examined aggression style in children who satisfied a diagnosis of ADHD (Waschbusch, Willoughby, & Pelham, 1998). This community study of kindergarden to 5th grade children compared the aggression styles of ADHD only, ADHD-ODD/CD, ODD/CD only, and normal control children. Approximately 77% of children identified as aggressive by the measure of reactive and proactive aggression also satisfied a diagnosis of ADHD. However, of these 77%, the majority (72%) met criteria for comorbid ADHD-ODD/CD. Overall, very few ADHD only children were identified as proactive aggressive only, rather the ADHD only children were more likely to be associated with reactive aggression than the comorbid ADHD children. That, no association has been found between inattention and aggression, suggests that any possible links between ADHD and aggression will be related to the impulse control deficits in hyperactive-impulsive children. There have been several studies showing high correlations between reactive aggression and impulsivity (Abikoff & Klein, 1992; Atkins & Stoff, 1993; Dodge & Frame, 1982; Dodge & Newman, 1981; Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Halperin et al., 1990). Indeed the average strength of intercorrelation between hyperactivity-impulsivity and aggression factors across 29 studies was .56 (Hinshaw, 1987).

Taken overall, that past studies have found reactive aggression to be associated with hostile attributional and response selection biases, whereas proactive aggression has not (Crick & Dodge, 1996; Dodge & Coie, 1987; Milich & Dodge, 1984;

Schwartz et al., 1997), appears to be the critical element defining any possible associations between ADHD and aggression type. Given that past research has shown mainly hyperactive-impulsive children, rather than inattentive children to display specific impulse control deficits it is expected that the H/I and C subtypes will have greater reactive aggression than the IA subtypes. Differences in aggression style among the DSM-IV subtypes will be examined in this study, and the results should provide further clarification of this issue.

5.4.3 Parenting style

Much of the research on parenting style has been guided by models that seek to define the affective climate and power structure present in the parent-child relationship (see Baumrind, 1973; Maccoby & Martin, 1983; Olweus, 1979; Rohner, 1986). Within these models, two key dimensions are used to differentiate parenting styles: parent warmth and parent control. Parent warmth broadly refers to parent responsiveness in terms of parent support, closeness, and availability. Parent control broadly refers to parent demandingness in terms of parent rejection, overprotection, hostility, and unavailability.

Several studies have indirectly examined parenting styles based on either DSM-III or DSM-IV diagnostic criteria (Faraone et al., 1998; Gadow et al., 2000; Lewis, 1992; Paternite et al., 1996). Although none of these studies specifically used measures of parenting style, they did consider global measures of family functioning, including family cohesion and conflict, family system maintenance, as well as mother-child relations. Taken together, the results of these studies were mixed. While DSM-III studies, indicated that ADDH children had lower family functioning than ADD children (Lewis, 1992), or had more home family problems and family therapy than ADD children (Barkley, DuPaul, et al., 1990), the DSM-IV studies either suggested no differences between the ADHD-IA, H/I, C subtypes, and normal controls (Faraone et al., 1998; Paternite et al., 1996), or suggested that the three ADHD subtypes had more family functioning problems than controls (Gadow et al., 2000). Although showing no overall group differences for family system maintenance, one of these studies (Paternite et al., 1996) indicated that, of the three subtypes, the ADHD-C subtype had more family cohesion and conflict problems than controls.

The mixed findings may be related to the lack of attention given to comorbid ODD and aggression, for when such comorbidity effects were controlled a more consistent picture has emerged, with ODD and aggression, but not ADHD associated with negative and rejecting parenting (Barkley, Fischer, Edelbrock, & Smallish, 1991; Harvey, Danforth, Ulaszek, & Eberhardt, 2001; Johnston, 1996; Lindahl, 1998).

Recent studies have examined child perception of parenting styles (Gomez & Gomez, 2000, Gomez et al., 2001; Gomez & Gomez, 2003). These studies have shown that aggression/ODD, and not hyperactivity-impulsivity/ADHD, is associated with child perception of negative maternal control and low maternal support among children with high aggression, hyperactivity, ADHD, and ODD. Overall, therefore, it would appear that the different ADHD hyperactive-impulsive subtypes are unlikely to differ from each other in terms of parenting styles (actual or child perception), especially when aggression and/or comorbid aggression are screened. As this has not been tested, a test of this is included in this study.

5 . 4 . 4 Summary of social cognition, aggression style, and parenting style findings based on DSM-III and DSM-IV studies

To date, while very few studies have examined ADHD in relation to the constructs of social cognition, aggression style, and parenting style, the available findings have indicated that hostile-biased social cognitions are related to increased childhood aggression. With respect to differences among ADHD subtypes for these constructs, more recent research has shown that due to impulse control-related deficits the H/I and C subtypes are more likely than the IA subtype to have increased impulse-reactivity that may be manifested as a reactive aggression style. In turn this reactive aggression style may be associated with hostile-biased social cognitions.

By contrast, studies have shown that the type of deliberately planned, direct, and usually overt instrumental actions involved in proactive aggression are not associated with ADHD, and therefore any of the ADHD subtypes. While to date no study has examined covert aggression, that it is also characterised by deliberate or planned, albeit covert instrumental actions, suggests that it is similar to proactive aggression. As such it is contended that neither of the instrumental aggression styles will be associated with the ADHD subtypes.

Finally, the results of the few studies that have examined associations between ADHD and parenting style have shown that ADHD per se is not associated with problematic parenting styles. Findings have indicated that aggression/ODD, rather than hyperactivity-impulsivity, appears associated with problematic parenting style, and that it is unlikely that the H/I and C subtypes will differ from each other in terms of parenting style, especially when aggression/ODD is screened.

5 . 5 Overall summary and implications of findings

In terms of the variables to be examined in this study, the preceding literature review has detailed the following. Part 1, has provided a comprehensive review of subtype studies from DSM-III, and DSM-IV, respectively, for the following correlates: aggressive and externalising behaviours; neuropsychological, neurological, psychophysiological, and motor functioning; IQ and academic functioning; anxiety, depression, and other internalising problems; family functioning; parent mental health; and peer relations. Part 2, has provided a review of those variables to be examined in this study that hitherto have not been investigated in relation to subtypes. These are social cognition, aggression style, and parenting style.

A synthesis of the findings for ODD, disruptive behaviour, and delinquency has shown a clear association with the H/I and C subtypes rather than the IA subtype. These findings prevailed for both clinical and normative samples. By contrast, subtype findings for other childhood externalising behaviours associated with the constructs of peer relations, family functioning, and parent mental health, are far less clear. The evidence for peer relations provided mixed results. Nevertheless, there does appear sufficient evidence to suggest that the combined effects of the dimensions of inattention and hyperactivity may predispose the C subtype to greater peer-related difficulties than either of the separate effects of inattention associated with the IA subtype, or hyperactivity-impulsivity associated with the H/I subtype. This suggests that it is the combination of the dimensions of inattention (eg., low self-confidence), and hyperactivity-impulsivity (eg., rash and inappropriate actions) that directly leads to more peer related problems.

For the family functioning, and parent mental health constructs, the paucity of studies hinders our understanding of subtype differences. Within a developmental psychopathology framework, family factors, including parent mental health, have been identified as risk factors associated with ADHD (Hinshaw, 1994; Johnston & Mash, 2001; Rutter & Sroufe, 2000). The very limited evidence from subtype studies indicated few differences between subtypes, with perhaps the C subtype having marginally more family-related problems than the IA and H/I subtypes who did not differ from each other. Given the paucity of evidence there is a need for further studies in this area.

The subtype data for distinctions between such variables as neuropsychological, neurological, psychophysiological and motor functioning, and IQ and academic functioning, is inconclusive. For neuropsychological, neurological, psychophysiological, and motor functioning the data has indicated that any subtype differences, especially those between the IA and C subtypes, are subtle and qualitative and may be related to differences in neuroanatomical structure and function. Moreover recent neurological studies have suggested that subtype differences are less likely to be found, unless future studies take into account the effects of age, gender, and maturational effects.

Within the handful of studies, for IQ and academic functioning there were few systematic differences among subtypes. There was some evidence to suggest that children with hyperactivity-impulsivity (i.e., H/I subtype) have slightly higher IQ and academic functioning than children with inattention (i.e., IA and C subtypes). Given the paucity of studies, particularly for clinic samples, there is a need for further studies in this area.

Although there were no clear subtype distinctions among the handful of studies (mainly normative samples) for anxiety, the DSM-IV results suggested that children with inattention (i.e., IA and C subtypes) appear to have marginally more anxiety-related problems than children with only hyperactivity-impulsivity (i.e., H/I subtype). The limited number of studies, the lack of clinic samples including the three subtypes, and the lack of distinction among the subtypes, suggests the need for further studies with ADHD children in this area.

In addition, the preceding review has focused on several important variables (i.e., social cognition, aggression style, and parenting style) that hitherto have not been examined in association with ADHD subtypes. With respect to social cognition, as one of these variables, a synthesis of the findings for ODD/CD, disruptive behaviours, and delinquency, has shown that there is sufficient evidence to suggest that ADHD per se is not necessarily associated with hostile-biased social cognition. Rather it appears that the impulse-control deficits associated with the H/I and C subtypes (and not the IA subtype) may lead to greater levels of reactive aggression, and in turn, a reactive aggression style may be a predispositional factor that may lead to more hostile-biased social cognition.

Clearly the evidence from recent studies also indicates that there is no association between proactive aggression (and by implication covert aggression) and ADHD. On the other hand, parenting style studies have shown no association between ADHD per se and problematic parenting. From the findings in these studies, it is clear that ODD and its associated aggressive behaviours, rather than hyperactivity-impulsivity is associated with parenting style, and it is unlikely that the ADHD subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes) will differ for parenting style. To further test the relative merits of recent findings, there is the need to examine the social cognition and aggression style variables with, and without controlling for the influence of ODD, with a group of ADHD children.

Taken together, the evidence from an extremely comprehensive review of the DSM-III and DSM-IV subtypes in the existing studies, and the pattern of suggested association for the social cognition, aggression style, and parenting style variables, has indicated few consistent subtype distinctions. Such findings may suggest that differences between the different dimensions of inattention and hyperactivity-impulsivity do not necessarily lead to reliable subtype differences. It also may be that past methodology and design problems, especially the failure to screen for comorbidity effects in the majority of studies reviewed, has obfuscated any possible distinctions between the subtypes, and the true relationship between the ADHD dimensions and the different subtypes. Indeed the broader implications of such issues can be seen by reference to those few studies that did screen for comorbidity effects. For instance, DSM-III and DSM-IV studies screening for comorbidity with ODD and conduct problems, have found that the effect of screening for

ODD/conduct problems was to reduce the degree of differences among the ADHD subtypes. Similarly, in a totally different area, for anxiety, a DSM-IV study showed that without screening for comorbidity with conduct problems, there was little differentiation between subtypes. After screening for comorbidity effects, the C subtype had greater anxiety than the IA or H/I subtypes.

Such findings suggest, that even though the majority of findings have been based on samples of clinically-referred children, the critical failure in most studies to screen for comorbidity with ODD and conduct problems, has obfuscated distinctions between subtypes. Clearly, as the results of those studies that have screened for comorbidity effects have illustrated, a better understanding of the true validity of the ADHD subtypes will be obtained by examining the ADHD subtypes, only if comorbidity effects are taken into account.

In conclusion, it is requisite that if future studies examining the external validity of the ADHD subtypes are to discern the true relations between subtypes, then such studies should be based on ADHD diagnosed children rather than normative samples. Moreover, if such studies are to provide greater clarity with regard to distinctions between subtypes, then their designs should be premised on comparisons between the subtypes, with, and without screening for comorbidity effects.

CHAPTER 6

AN EXAMINATION OF THE DIFFERENCES IN DSM-IV ADHD SUBTYPES FOR IQ, ACADEMIC FUNCTIONING, ODD, AGGRESSION STYLE, SOCIAL INFORMATION PROCESSING, PARENTING STYLE, AND PARENT MENTAL HEALTH

6 . 1 Introduction

The previous chapter provided a comprehensive review of studies based on DSM-III and DSM-IV for differences among ADHD subtypes on a broad range of measures. These measures included variables that will be examined in this study, such as IQ, academic functioning, ODD, anxiety, and parent mental health. In addition, in the previous chapter a review was undertaken of several other measures that hitherto have not been considered with subtypes. These variables were social cognition, aggression style, and parenting style.

As previously noted, for those measures that have been examined with subtypes, for ODD there appears a clear association with the H/I and C subtypes, but for IQ, academic functioning, anxiety, and parent mental health there were mixed results. For those measures yet to be examined with ADHD subtypes (social cognition, aggression style, parenting style), the available findings intimate that comorbidity with ODD may potentially obfuscate distinctions among subtypes.

Moreover, given that so few past studies screened for ODD it is likely that, from the results of those few studies that did screen for ODD, the existing findings may be suspect, particularly for those variables that past findings have indicated may have some behavioural characteristics in common with ODD, such as aggression, school and home behaviour, peer relations, and family functioning. This study has been designed to examine the external validity of the ADHD subtypes, with, and without controlling for the effects of ODD.

6 . 2 Aim of Study

The aim of the study was to compare the ADHD subtypes and controls for the variables mentioned above. Given that past data has indicated that the majority of subjects in the H/I and C groups had externalising or comorbid ODD behaviours (see Table 20), the study also will compare these groups after partialing out ODD. The latter will enable examination of specific differences without the effect of ODD.

6 . 3 Justification for hypotheses of the study

The majority of past DSM-III studies did not screen for comorbidity with ODD or other psychiatric disorders, and possibly had other design flaws. In addition, the DSM-III symptom descriptors are not identical with DSM-IV for item numbers, item classification, or item type. Given that the ADHD symptom organisation in DSM-IV is much more empirically based, the DSM-IV system is better designed, and the fact that several DSM-IV studies have screened for comorbidity with ODD, DSM-IV was used as the basis for predictions in this study. Finally, given that there are a large number of variables in this study, for the purposes of brevity the following hypotheses have been framed in tabular form (see Table 22).

In summary, it is expected that, the dimension of hyperactivity-impulsivity, either as the H/I subtype per se, and/or the C subtype, rather than the inattention dimension as the IA subtype per se, will be associated with elevations in externalising behaviours such as ODD, SIP, aggression style, parenting style, and parent mental health. By contrast, it is expected that the dimension of inattention, (i.e., either as the IA subtype, and/or the C subtype), rather than hyperactivity-impulsivity (i.e., H/I subtype), will be more associated with elevations in less externalising behaviours such as IQ, academic functioning, and anxiety.

With respect to comorbidity effects with ODD, based on the results of the extremely limited number of DSM-III, and DSM-IV studies that have screened for the effects of ODD, it is more likely that ODD will have a greater influence on the two subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes) than the subtype with only inattention (i.e., IA subtype). It is expected that screening for ODD will generally only influence those externalising variables found by past studies to have some association with ODD, such as SIP, aggression style, parenting style, and parent mental health.

It should be also be noted that in terms of the hypotheses made in this study, that the hypotheses for IQ, academic functioning, anxiety, family functioning, and parent mental health, are based on only a handful of studies, and very few of these studies examined all three subtypes within the same study. It also needs to be noted that there are also data showing mixed results for IQ, academic functioning, anxiety, family functioning and parent mental health.

Table 22

Summary of Hypotheses for Expected Group Differences Among ADHD Subtypes, and Control Group

Variables	Expected group differences	Expected group differences after partialing out ODD
ODD	H/I = C > IA > Ctl	H/I = C > IA > Ctl
IQ	H/I > IA = C < Ctl	H/I > IA = C < Ctl
Maths performance	IA < C < H/I < Ctl	IA < C < H/I < Ctl
Spelling performance	IA = C < H/I < Ctl	IA = C < H/I < Ctl
Reading performance	IA = C < H/I < Ctl	IA = C < H/I < Ctl
Anxiety	IA = C > H/I > Ctl	IA = C > H/I > Ctl
<u>SIP</u>		
Interpretation of intent	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**
Response selection	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**
Emotional reactivity	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**
<u>Aggression style</u>		
Reactive	H/I = C > IA > Ctl	H/I = C > IA > Ctl
Proactive/Covert	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**
<u>Parenting style</u>		
Rejection/Overprotection	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**
Warmth	IA > H/I = C < Ctl	IA > H/I = C < Ctl
Parent mental health	H/I = C > IA > Ctl	**IA = H/I = C > Ctl**

Note: IA = inattentive subtype, H/I = hyperactive-impulsive subtype, C = inattentive and hyperactive-impulsive subtype, Ctl = control group; the bold entries indicate expected differences after partialing out ODD.

6 . 4 Method

6 . 4 . 1 Participants

. This sample of children was a subset of the sample obtained in Study 1. There were 129 children in the study, 95 ADHD children and 34 control children. Gender breakdown showed that for the ADHD groups there were 80 boys and 15 girls, and for the control group there were 18 boys and 16 girls. Demographic characteristics are presented in Table 23. The ADHD children were recruited from a paediatric clinic located at Geelong, a large provincial city about 70 kilometres from Melbourne. Subjects were almost equally divided between locations from the outer western suburbs of Melbourne, and locations in Geelong and surrounding districts. The control group was recruited from the same outer western suburbs of Melbourne, the provincial city of Geelong, as well as Ballarat another large provincial city, located about 100 kilometres from Melbourne.

The sample of ADHD children was chosen as follows. At stage 1, a paediatric clinic provided client lists of children currently diagnosed with ADHD, but none of the children had been diagnosed according to DSM-IV subtype. At stage 2, letters were sent to parents about the study, and inviting the children's participation in the study. Parents who consented to their child's participation were then contacted. To confirm diagnosis, telephone conversations were conducted with mothers of ADHD children, based on a DSM-IV clinical interview. At stage 3, for those children who were deemed to satisfy ADHD diagnosis, mothers were asked to complete a DSM-IV Rating Scale (Gomez & Condon, 1999; Gomez et al., 1999; Gomez & Gomez, 2003). Allocation of ADHD children into different subtypes was based on responses to the ADHD scale. At stage 4, teachers were contacted and asked to complete the DSM-IV Rating Scale. Subsequently, the final sample of ADHD children comprised only those children for whom the ADHD scale had been completed by both mothers and teachers.

The ADHD rating scale comprised the 18 DSM-IV ADHD symptoms and is divided into two groups, with one group the nine IA symptoms, and the other group the nine H/I symptoms. This scale is similar to the new DSM-IV ADHD scales used in studies in the United States (e.g., DuPaul et al., 1997, 1998; Gaub & Carlson, 1997a). Parents and teachers rate the occurrence of each symptom on a 4-point scale (0 = "not at all", 1 = "just a little", 2 = "pretty much", 3 = "very much"). The inattentive subtype required endorsement of at least 6 IA symptoms, the hyperactive-impulsive subtype required endorsement of at least 6 H/I symptoms, and the combined subtype required endorsement of at least 6 IA symptoms and 6 H/I symptoms. Generally in such scales, ratings of either 2 or 3 on an item have been interpreted as an indication of the presence of that symptom (Baumgaertel et al., 1995; DuPaul, 1991; Gomez et al., 1999; Pelham et al., 1992).

Gomez and associates have provided information on the psychometric properties of the DSM-IV ADHD rating scale. Overall, their studies involving Australian primary school children, indicated alphas of above .90 for IA and H/I subscales for teacher and parent ratings (Gomez et al., 1999). Gomez et al. (1999) found the 3-

month test-retest reliability for parent ratings of the IA and H/I symptoms to be .45 and .44, respectively, whereas for teacher ratings they were .70 and .75, respectively. In relation to concurrent validity, the correlations between parent ratings of the IA and H/I symptom groups, and the Abbreviated Conners Parent Rating Scale (Goyette, Conners, & Ulrich, 1978) were .76 and .86, respectively. In terms of construct validity of the IA and H/I subscales, CFA of both parent and teacher ratings showed good fit for a two-factor model, corresponding to how the ADHD symptoms are organised in DSM-IV (Gomez et al., 1999 Gomez et al., 2003). Also CFA MTMS analysis provided good support for both convergent and discriminant validities of the IA and H/I constructs at the matrix level (Gomez et al., 2003).

Although the diagnosis of ADHD requires the presence of cross-situational symptoms, the criterion was not imposed. In this study, group allocation was based on mother ratings only. This was because most of the participants with ADHD were on stimulant medication while at school, and teachers reported considerable improvements in school behaviour. As in previous studies, (e.g., Iaboni, Douglas, & Baker, 1995), all participants who were on stimulant medication had been drug free for at least 48 hours prior to testing For children to be included in the ADHD groups, it was also necessary for mothers to have indicated that the participants' problems had a duration of at least 12 months.

In addition, in line with accepted clinical and research practice (Barkley, 1990), all participants had IQ's above the level set for intellectual disability (at least 80 or above), and had no sensory, motor, or severe emotional problems, as reported by mothers or teachers. IQ was obtained by prorating Wechsler Intelligence Scale for

Children (WISC-III; Wechsler; 1991) Vocabulary and Block Design scores. These subtests scores were used because the prorated IQ scores derived from them have high reliability ($r = .91$) and validity ($r = .86$) coefficients (Sattler, 1992).

All participants were also screened for comorbidity with ODD with the use of an ODD Rating Scale based on the 8 DSM-IV ODD symptoms. Scoring for this scale was based on the same 4-point system as applied with the ADHD scale with ratings of either 2 ("pretty much") or 3 ("very much") for each item indicating the presence of a symptom. Mother ratings were used because mother ratings of ODD are regarded as more reliable than teacher ratings, and negative parent-child interactions are regarded as an important marker for ODD/conduct problems (Mash & Barkley, 1996). ODD comorbidity rates for the subtypes showed that the H/I and C subtypes had greater comorbidity than the IA subtype (see Table 23).

6.4.2 Measures

There were 3 groups of measures, (1) child measures, (2) teacher measures, and (3) mother measures. The child measures were IQ, the WIAT subtests for spelling, maths, and reading, child SIP, and child perception of maternal childrearing style. The teacher measures were anxiety, and aggression style comprising the subscales of reactive, proactive, and covert aggression. Mothers completed the same scales as teachers, these being anxiety, aggression style as reactive, proactive, and covert aggression, and a general health questionnaire as an index of maternal mental health status.

6.4.2.1 Assessment of IQ

IQ was measured with a two-item WISC-III test (Wechsler, 1991). This short form test comprised the sub-tests Vocabulary and Block Design. Levy (1967) found an interrelation of .90 between short form and Full Scale IQ tests. For the short-form Vocabulary and Block Design test, Sattler (1992) found reliability coefficients of .91 and validity coefficients of .86. Similarly, for the same short-form IQ test, Campbell (1998) found corrected validity coefficients of .82, and split-half reliability estimates of .91, and correlations with the K-TEA of .63.

This measure was used to test whether there were any IQ distinctions between the ADHD groups, and between the ADHD children and non-ADHD children, given that past studies have failed to provide consistent evidence of IQ distinctions among subtypes, or between ADHD children and non-ADHD children. It was hoped that this sample of clinically diagnosed ADHD children might serve to further clarify this issue.

6.4.2.2 Assessment of academic functioning

Academic functioning was measured with the three-subtest screener of the Wechsler Individual Achievement Test (WIAT; Weschler, 1992). The screener comprises the subtests, Basic Reading, Mathematics Reasoning and Spelling. The WIAT manual reported age-based reliability coefficients for the subtests, ranging between .80 to .93 for spelling, from .74 to .90 for maths, and from .87 to .94 for reading. Test-retest reliability coefficients for spelling were .95, maths .89, and reading .94. Average stability coefficients from grades 1-8 for spelling ranged between .94 to .95, for maths between .84 to .89, and for reading between .85 to .92. Evidence of concurrent validity was shown by the correlations between the WIAT and Kaufman Test of Educational Achievement (K-TEA; Kaufman & Kaufman, 1985). Intercorrelations for spelling, maths, and reading subtests were shown to be .73, .87, and .86, respectively. Further corroboration of concurrent validity was given by correlations between the WIAT screener tests and the Basic Skills Individual Screener (BASIS; The Psychological Corporation, 1983), for children grades 3-8, with correlations ranging between .79 to .90.

This measure was used as a preliminary indicator of learning problems, given that many past studies have shown that ADHD children with purely inattention problems have more learning difficulties than ADHD children with purely hyperactive-impulsive problems, and non-ADHD children. In addition it was hoped that the WIAT screener test would provide further clarity as to possible academic distinctions (i.e., maths versus language functioning) between the two subtypes with inattention (i.e., IA and C subtypes).

6.4.2.3 Assessment of anxiety

Anxiety was measured with the anxiety subscale of Rutter's assessment of general home behaviour scale (Rutter, Tizard, & Whitmore, 1970). This scale was developed as a screening clinical instrument to detect behavioural disturbances among children in the age range 8-13 years. The anxiety subscale has 5 items and has been scored on a Likert format ranging between "0" (not at all) to "3" (very much). It comprises items covering: worries, solitariness, misery, fearfulness, and fussiness. McGee et al. (1985) reported that these items formed an anxiey-fearfulness factor, and for teacher ratings of boys it has good reliability (r = .72). This factor appears very similar to Rutter et al's. (1970) "neurotic " grouping of the items, and Venables et al. (1983) "anxious-fearful" factor.

This scale was used because, despite the fact that ADHD children have been shown to have greater anxiety than non-ADHD children, past studies have failed to show clear distinctions for anxiety among the ADHD subtypes. It was hoped that assessing anxiety with a group of clinically diagnosed ADHD children might further clarify relations among ADHD subtypes.

6 . 4 . 2 . 4 Assessment of aggression style

Childhood aggression was measured with an aggression style scale (Brown, Atkins, Osborne, & Milnamow, 1996) based on the dimensions of reactive and proactive aggression. This scale is based on the two 3-item reactive and proactive aggression scales developed by Dodge and Coie (1987). Dodge and Coie (1987) had proposed two types of proactive aggression: instrumental-proactive aggression, which is governed by reinforcement principles such as aggression for object acquisition; and hostile-proactive aggression, which is governed by the tendency to overvalue the outcome of aggression and underestimate its impact on victims. However Dodge and Coie's scale did not separate the two types of proactive aggression. Brown et al. (1996) separated the two types of proactive aggression by using a proactive aggression subscale to measure hostile and more direct and overt aggression, and a covert aggression style subscale to measure sneaky and more indirect or hidden aggression. The revised scale (Brown et al., 1996) comprises 21 items measuring the three subscales of reactive, proactive, and covert aggression. The scale comprises 7 items for each of the three subscales. The scale has a 3-point format ("0" = never, "1" = sometimes, "2" = very often). The scale had high internal consistency, with alpha coefficients for the two reactive and proactive aggression factors of .94, and .92, respectively. Both factors were moderately highly correlated with each other ($r = .70$, $p < .001$).

The dichotomy between reactive and proactive aggression has also been confirmed in other studies. Using CFA and other procedures, researchers have found strong support for the internal, convergent, and discriminant validity of the reactive and proactive aggression constructs (Crick & Dodge, 1996; Dodge, Pettit, Bates, & Valente, 1995; Price & Dodge, 1989; Weiss, Dodge, Bates, & Pettit, 1992). More recently, Poulin and Bouvin (2000) using a CFA procedure, compared one and two factor models for aggression style, and found the two factor model of reactive and proactive aggression provided a very good fit to the data, while the one factor model provided a very poor fit.

Aggression style was measured in this study because aggression/conduct problems have been regarded as important markers for child psychopathology (especially ODD/CD), and more specifically, distinctions between the dimensions of inattention and hyperactivity-impulsivity. As to date, distinctions in aggression style have not been examined as subtypes, it was hoped that this study might be useful in further clarifying this issue.

6 . 4 . 2 . 5 Assessment of social information processing

SIP was assessed by an adapted version of the Interpersonal Problem Solving Analysis (IPA) developed by Marsh (1982). Subjects were given six short stories to read. Each story was three short sentences in length, and all stories were of ambiguous intent category.

An example of a story is as follows:

You are at the beach enjoying an ice-cream. A child throws sand in your direction. Some of it lands on your ice-cream.

After each story, questions were asked to assess aspects of the social information processing model as proposed by Crick and Dodge (1994). Each child was asked three peer-related questions. The first question tapped the child's representation of the peer's intent. The question comprised two parts and is as follows: *Why did he/she do this*? If the subject did not reply with an intentional attribution he/she was then asked *Did he/she do it on purpose or by accident?* The next question, *What would you do next after this happened?*, tapped the child's representation related to responding to the event. The third question tapped the subject's emotional response or feelings by asking *How would you feel after this happened?*

Responses to each question were coded as indicating either a positive or negative representation related to the event. For question one, subject representation of peer intent was coded as positive (score of "0") when children attributed an accidental intent to the peer (eg., *It wasn't on purpose, It was an accident*), and subject representation of peer intent was coded as negative (score of "1") when children attributed a deliberate or purposeful intent to the peer (eg., *It was on purpose, he/she* *wanted to upset me*). For question two, relating to what action the subject would take, subject response was coded on a 5-point scale ranging between "0" (*walk away, ignore him/her*), "1" (*talk to him/her, ask why he/she did it*), "2" (*tell the teacher, tell mum/dad*), "3" (*yell at him/her*), "4" (*hit him/her*). For question three, relating to subject emotional response, a similar 5-point format was used, ranging between "0" (*I'd feel OK/not upset*), "1" (*not so good*), "2" (*upset*), "3" (*quite upset*), "4" (*angry*). Subject scores for each question were the total score across all six short stories, ranging between 0-6 for question 1, and 0-24 for questions 2 and 3, respectively.

The order of the SIP stories was randomised. The scores used for analyses were the total scores across the 6 stories for attribution of intent, response selection, and emotional response. The responses of the children were recorded verbatim, and were coded by an independent rater who was blind to the aims of the study The inter-rater agreement was computed using the intaclass correlation method. For attribution of intent the inter-rater agreement was .95, for response selection .95, and for emotional response .93. Gomez and Gomez (2000), and Gomez et al. (2001) also found that children with higher aggression had increased scores for attribution of intent and response selection.

This scale was used to assess differences among the subtypes for hostile-biased social information processing. Past studies (Gomez & Gomez, 2003), have shown that hyperactive-impulsive children with increased aggression levels have greater social cognitive deficits, and that thereby ADHD children with hyperactivity-impulsivity are more likely to have greater social cognitive deficits than ADHD children with inattention. However, to date no study has examined social cognitions with ADHD subtypes, and in particular whether any of the two hyperactive-impulsive subtypes (i.e., H/I or C subtypes) is more predisposed toward social cognitive deficits. It is hoped that this study will clarify this issue.

6.4.2.6 Assessment of parenting style

Perceived parental rearing behaviours were measured with a scale evaluating parent warmth, rejection, and overprotection. Children completed a revised form of the Egna Minnen Betraffande Uppfostran for children (EMBU, English version; Perris, Jacobsson, Lindstrom, & von Knorring, 1980). The revised scale (Castro, Toro, van der Ende, & Arrindell, 1993) has three subscales (parent warmth, rejection, and overprotection), and comprises 34 questions rated on a 4-point format, ranging between 1 = "no, never", to 4 = "yes, most of the time". There are 14 items for the warmth subscale, and 10 items for each of the rejection and overprotection subscales.

EFA studies have generally supported the dimensions of the EMBU. Winefield, Tiggeman, and Winefield (1994) found support for a three-factor structure of warmth, rejection, and overprotection, while Muris, Bogels, Meesters, van der Kamp, and van Oosten (1996) revealed a two-factor solution with warmth as factor 1 and rejection and overprotection as factor 2. Castro et al. (1993) showed that CFA procedures supported a three-factor model of the EMBU. For the three-factor model, the χ^2 was approaching non significance, the RMSEA was 0.05 or smaller, and the AGFI was close to 0.90.

Arrindell, Hanewald, and Kolk (1989) indicated that Australian, British, and Dutch samples had shown similar associations for the EMBU subscales, with parent warmth and rejection significantly negatively correlated. Castro et al. (1993) reported good internal consistency with alpha's for the parent warmth and rejection subscales 0.78 or above, but overprotection had only moderate consistency with values ranging between 0.58-0.61. Meesters, Muris, and Esselink (1995) found the reliability for the subscales ranged between 0.68 to 0.87, with an overall average score greater than 0.70.

Winefield, Goldney, Tiggeman, and Winefield (1990) found correlations between the EMBU and measures of psychological adjustment were generally negatively correlated for parent rejection and overprotection, and positively correlated for parent warmth. Test-retest reliabilties computed over a 4-year period have shown correlations generally greater than 0.70 for warmth, 0.75 for rejection, and 0.60 for overprotection. Comparison between the EMBU and the Parent Bonding Instrument (PDI) has also provided excellent support for the convergent and discriminant validity of the EMBU warmth and rejection scales, but only modest support for the overprotection scale (Arrindell, Gerlsma, Vandereycken, Hageman, & Daeseleire, 1998).

This scale was used because similar to aggression style, negative child-parent interactions have often been regarded as a precursor to child antisocial behaviour and the development of more externalising and problematic behaviours such as ODD and/or CD. Although, in general, specific aspects of parenting style have been examined with ADHD children, to date no study has specifically examined differences among subtypes, hence details of relations between maternal psychopathology and ADHD subtype would be useful.

6 . 4 . 2 . 7 Assessment of maternal general health status

An index of general health status was used to measure mother mental health. Mothers completed a modified 28 item scale based on the general health questionnaire (GHQ; Goldberg, 1972) As an index of maternal mental health, four, 7-item subscales comprising, somatic, anxiety and insomnia, social dysfunction, and depression, were used. The GHQ manual (Goldberg, 1991) has indicated total scale reliability coefficients ranging between .67 to .83, and the use of ROC analysis has indicated specificity and sensitivity values greater than 80%. In addition, the manual has reported that 43 validity studies of different forms of the GHQ have evidenced average sensitivity and specificity rates of .84, and .82, respectively. Specifically concerning the 28-item GHQ, studies reporting on the validity of this version have indicated sensitivity values ranging between 44% to 100%, with median values of 86%. Values for the specificity range between 74% to 93%, with the median value being 82%.

This scale was used because many past studies of ADHD children have suggested that differences in parent mental health may be related to differences among the ADHD behaviours displayed by the child. In particular, higher levels of noncompliance, aggression and antisocial behaviour in ADHD children have been associated with greater levels of marital distress, family dysfunction, and maternal depression. While several past ADHD studies have examined maternal psychopathology, to date none has examined the relations between differences in maternal psychopathology and differences among ADHD subtypes. It is hoped that this study will show whether there are differences among subtypes for maternal mental health status.

6 . 4 . 3 Procedure

Initially, details were obtained of children with ADHD based on clinical diagnosis from a paediatric clinic. The ADHD children generally comprised relatively equal numbers from both metropolitan, and semi-rural and rural locations in the western part of the State of Victoria, Australia. Subsequently, 330 letters providing details of the study, together with consent forms, including provision for home parental telephone numbers, were sent to parents of ADHD children. To minimise response bias, the introductory and explanatory letters informed parents that the study was investigating childrens' home and school behaviour, and the rating scales were not identified by name.

From this initial data pool, 153 affirmative responses were received from the parents. Subsequently, the researcher contacted each of the consenting parents by telephone to provide them with further details of the study, to clarify any possible concerns regarding participation in the study, and to arrange a suitable time for the researcher to visit the parental home and conduct the interviews/questionnaires with parents and testing of the child or children (with some families having more than one ADHD child). During this telephone contact, those parents still willing to participate in the study were administered an ADHD clinical interview based on DSM-IV criteria to confirm current ADHD diagnostic status. Based on these interviews, 24 children were regarded as no longer fulfilling an ADHD diagnosis.

After completion of the parent clinical interview, the researcher visited each of the families of those children fulfilling an ADHD diagnosis and conducted the formal testing program with parents and children. At this time parents were also requested to contact their child's teacher, and ask him/her to complete several of the same questionnaires that had been completed by the parents. This process was designed to obtain cross-situational data for the DSM-IV ADHD Rating Scale, the DSM-IV ODD Rating Scale, the Rutter anxiety subscale, and child aggression style scale.

From this process, data was received from 113 teacher and mother combinations, however, a further 18 children were excluded from the study because they did not satisfy the cross-situational criteria stipulated by DSM-IV. Responses to the DSM-IV ADHD Rating Scale were then used to group the children into DSM-IV ADHD subtypes, and as previously noted, these subtypes were based on mother ratings. In addition, further data was obtained from mothers only, pertaining to self-rated general health status. This data was then combined with child data for further analysis. Finally, the same explanatory letter, consent, interview, and testing procedures were used to obtain control group data. The control group was obtained from the same metropolitan and semi-rural locations, so as to approximate the selection criteria used for the ADHD children.

6 . 5 Demographic information

Initially comparisons were made between teacher and parent ratings of ADHD subtypes. As previously indicated 6 or more IA and 6 or more H/I symptoms were requisite for each of the former subtypes and 12 or more symptoms (6 or more IA and 6 or more H/I symptoms) were requisite for the C subtype. Of the 95 ADHD children in the study, for the IA subtype teachers and parents identified 63 and 81 children respectively. The degree of agreement between teachers and parents was 78%. For the H/I subtype teachers and parents identified 43 and 61 children respectively, with a 70 % agreement between teachers and parents. For the C subtype teachers and parents identified 35 and 52 children respectively, with a 67% agreement between teachers and parents.

Subsequently information was collected on family characteristics, maternal education, and occupational status, as well as medication status of each ADHD child. This information is presented in Table 23.

There was a greater than 4:1 ratio of males to females for the subtypes, but the control group had a relatively equal gender ratio. There was no age difference among the groups. For family type, the percentage of IA and C subtypes from two-parent families were fewer than the control group, but there were no differences among the subtypes for percentage of sole parent families, although each of the three subtypes had significantly more sole parents than controls. There were no group differences for numbers of children in family. For the percentage of mothers who left school prior to 17 years there were subtype differences, with more mothers of the C subtype leaving school prior to 17 years than the IA subtype and the control group. There were no group differences for maternal occupation type or percentage of mothers employed, although mothers of the C subtype had less employment than the other groups.

For medication, more than 80% of the ADHD children were receiving medication, and more than 80% of ADHD children taking medication were on the psychostimulants, dexamphetamine or methylphenidate (ritalin), however there were no subtype differences for psychostimulant usage. Similarly, there also were no subtype differences for length of time on medication. Also nearly 90% of mothers of each subtype indicated that they had received training in behavioural management of their children. Finally, the hyperactive-impulsive subtypes (i.e., H/I and C subtypes) had greater ODD comorbidity than the subtype with inattention per se (i.e., IA subtype).

Table 23

Clinical and Demographic Characteristics of ADHD Subtypes and Control Children

Measure	IA (n = 32)	H/I (n = 11)	C (n = 52)	Ctl (n = 34)	Test Statistic	LSD pairwise comparisons (sig. at p < .05)
Male %	87.5	90.9	80.8	52.9	$\chi^2 = 14.40$**	IA = H/I = C > Ctl
Mean (SD) Age	10.66 (1.69)	10.40 (1.37)	10.54 (1.47)	10.59 (1.56)	F = 0.11	No group differences
<u>ODD comorbidity</u>						
%Total	32	82	81	--	$\chi^2 = 49.83$**	H/I & C > IA
% Male	71.9	72.7	80.8	--	$\chi^2 = 3.40$	No group differences
<u>Family type</u>						
% Two-parent	71.8	72.7	63.46	88.2	$\chi^2 = 22.60$**	C & IA < Ctl
% Sole-parent	28.2	27.3	36.54	11.8	$\chi^2 = 35.64$**	IA = H/I = C > Ctl
Age mother left school (% < 17 yrs.)	46.9	36.4	65.4	36.4	$\chi^2 = 9.29$*	C > IA & Ctl
% Maternal employment	75	72.7	63.5	79.4	$\chi^2 = 2.88$	No group differences
Maternal occupation♣	3.16 (1.82)	4.40 (1.57)	4.31 (2.04)	3.06 (2.01)	F = 4.21	No group differences
<u>Medical information</u>						
Years since diagnosed	2.2 (1.3)	2.4 (1.5)	2.5 (1.1)	--	F = 1.23	No group differences
Child medication						
% no. medicated	81.3	81.8	90.4	_	$\chi^2 = 2.92$	IA = H/I = C
% no. on psychostimulants	78.1	72.7	78.8	_	$\chi^2 = 3.50$	IA = H/I = C
Mean (SD) years on medication	2.28 (1.8)	2.64 (1.8)	2.98 (1.9)	_	F = 1.42	IA = H/I = C
% Psychosocial intervention	87.5	90.9	88.5	--	$\chi^2 = 0.83$	No group differences

Note: IA = inattentive subtype; H/I = hyperactive-impulsive subtype; C = combined inattentive and hyperactive-impulsive subtype; Ctl = control group; ♣ maternal occupation based on Australian Standard Classification of Occupations (Australian Bureau of Statistics, 1996) based on 7 broad scales: 1 = professional; 2 = managerial; 3 = clerical and service; 4 = skilled trades; 5 = semi-skilled trades; 6 = unskilled trades; 7 = miscellaneous, including houseperson, pensioner, student, and unemployed. ** $p < .001$, * $p < .05$.

6 . 6 Results

The analyses will be presented in the following order. The child-derived dependent variables will be presented first, next the teacher-derived dependent variables, and then the mother-derived dependent variables. Initially descriptive information will be presented for the scores of the different measures. This will be followed by a comparison of the group differences without controlling for the effects of ODD, and subsequently group differences will be compared after controlling for the effects of ODD.

6 . 6 . 1 Child-derived dependent variables

6 . 6 . 1 . 1 Descriptive information

Table 24, shows the descriptive information for child IQ, academic functioning, SIP, and parenting style variables.

Table 24

Descriptive Information for Child-derived Dependent Variables

Symptoms	Mean	SD	Skewness	Kurtosis
IQ	104.77	14.02	.01	-.34
WIAT-Spelling	94.98	14.60	-.22	-.82
WIAT-Reading	95.60	14.74	-.09	-.76
WIAT-Maths	101.98	17.27	-.70	2.35
SIP – Intent	2.18	1.93	.53	-.91
SIP – Response	6.85	4.31	.84	.86

SIP – Feelings	13.52	5.88	-.20	-.53
Mother rejection	19.22	5.68	.79	.25
Mother overprotection	23.18	5.41	.16	-.61
Mother warmth	44.31	8.30	-1.29	1.79

Note: *SD* = Standard Deviation; SIP = social information processing

The skewness values ranged between –1.29 (parent warmth) to .84 (SIP warmth), and the kurtosis values ranged between 2.35 (WIAT maths) to -.91 (SIP intent). None of the variables were significantly skewed or kurtotic.

6.6.1.2 IQ and academic functioning

ADHD subtypes and controls were compared on IQ, and as shown in Table 25 there were no significant group differences. Planned comparisons also showed no group differences. After controlling for ODD the control group had higher IQ than the C subtype, but there were no subtype differences. Similarly for the WIAT subtests there were no group differences for spelling, and maths, but there were group differences for reading. Planned comparisons showed group differences only for the reading subscale, with the C subtype having lower scores than the control group. Controlling for ODD also showed group differences only for reading, with the C subtype having lower scores for reading than the IA subtype, and control group, and the relation between the C subtype and H/I subtype was approaching significance ($p < .06$), with the C subtype having lower scores than the H/I subtype.

Taken together, the results for IQ and academic functioning suggest that while the presence of ODD differentially influences relations between the subtypes and controls, ODD does not influence the scores of the three subtypes for IQ. Within academic functioning measures, it is only for reading that the removal of ODD showed the C subtype to have greater learning problems than the IA subtype and controls.

6.6.1.3 Social information processing

As shown in Table 25 there were significant group differences for attribution of intent. Planned comparison tests showed no differences among subtypes for attribution of intent, but the three subtypes had higher problem scores than controls. After screening for ODD the pattern of relations remained unaltered.

Similar to attribution of intent, there were group differences for response selection. Planned comparison tests showed no subtype differences, but the subtypes had higher problem scores and differed from controls. After screening for ODD, response selection no longer showed group differences. This result suggests that response selection scores among the groups were influenced by the presence of ODD. Planned comparison analysis revealed no subtype differences, but there were group differences between the C subtype and controls, and the relations between the IA subtype and control group was approaching significance ($p < .06$), as was the relation between the H/I group and controls ($p < .06$).

Table 25, indicates that there were group differences for feelings. Planned comparison analysis showed no subtype differences, but the C subtype and IA subtype had higher scores than the control group. After controlling for ODD, feelings showed no group differences, thus the effect of screening for ODD was to remove the differences between the C and IA subtypes and control group. Taken together, the results for SIP suggest that while the presence of ODD differentially influences relations between the subtypes and controls, ODD does not influence differences between the scores of the three subtypes for the SIP measures.

6 . 6 . 1 . 4 Maternal parenting style

Table 25 shows that there were significant group differences for mother rejection. Planned comparison tests indicated no subtype differences but each of the subtypes had significantly higher mother rejection scores than controls. After screening for ODD, there were no group differences, and this result indicates that the effect of screening for ODD removed the differences between each of the subtypes and the control group.

There were significant group differences for mother overprotection. Planned comparison analysis revealed no subtype differences, but each of the subtypes had higher scores and differed significantly from the control group. Similar to mother rejection, controlling for ODD showed no group differences, but planned comparisons showed the three subtypes to have higher scores than the control group, thereby indicating that ODD influences the relations between the three subtypes and the control group.

Table 25, also showed that there were group differences for mother warmth. Planned comparison tests showed no subtype differences, but the C subtype, and IA subtype had significantly lower mother warmth scores than the control group.

Screening for ODD removed the group differences, thereby indicating that ODD has influenced the relation between the IA and C subtypes and control group.

Taken together, these results showed no subtype differences for each measure of child perception of parenting style. Mothers of each of the three subtypes were perceived by their children to be more rejecting and overprotective than mothers of control children. For maternal warmth, both the IA and C subtype mothers were perceived by their children to have less warmth than mothers of controls. For each of the parenting style measures, ODD did not influence differences among subtypes, but did influence relations between the subtypes and control group.

Table 25

Group Comparisons of ADHD Subtypes and Normal Controls on Child-derived Measures

Variable	IA (n = 32)	H/I (n = 11)	C (n = 52)	Control (n = 34)	F ratio	Significant group differences based on LSD planned comparison tests (p < .05)
IQ						
ANOVA	102.13 (14.03)	107.73 (18.16)	102.63 (14.95)	109.56 (9.55)	2.34	No group differences
ANCOVA[♦]	101.49	107.55	102.93	109.81	1.97	C < Ctl; IA = H/I = C
WIAT – Reading						
ANOVA	98.09 (13.22)	100.36 (13.09)	90.57 (15.80)	99.41 (13.51)	3.65*	C < Ctl; IA = H/I = C
ANCOVA	98.41	99.58	90.27	100.48	2.80*	C < IA & Ctl; IA = H/I = Ctl
WIAT – Spelling						
ANOVA	95.72 (13.54)	96.45 (15.73)	91.48 (16.56)	99.15 (10.82)	2.03	No group differences
ANCOVA	95.72	94.27	90.16	102.11	2.29	C > Ctl; IA = H/I = C
WIAT – Maths						
ANOVA	101.41 (20.89)	106.73 (20.63)	90.56 (15.80)	104.68 (11.11)	0.90	No group differences
ANCOVA	101.14	104.83	98.62	107.25	1.14	No group differences
SIP – Intent						
ANOVA	2.25 (2.08)	2.91 (2.07)	2.77 (1.97)	0.97 (0.97)	7.59***	IA = H/I = C > Ctl
ANCOVA	2.25	2.81	2.74	1.11	2.78*	IA = H/I = C > Ctl
SIP – Response						
ANOVA	6.81 (3.99)	8.55 (4.59)	8.31 (4.30)	4.09 (3.13)	8.49***	IA = H/I = C > Ctl
ANCOVA	6.91	8.03	7.78	4.79	1.95	C > Ctl; IA = H/I = C

Table 25, continued

SIP – Feeling						
ANOVA	13.66 (5.37)	14.36 (5.59)	14.98 (6.16)	10.88 (5.30)	3.65	C > Ctl; IA = H/I = C
ANCOVA	14.00	12.33	13.43	13.65	0.23	No group differences
Mother- rejection						
ANOVA	19.28 (5.42)	21.00 (7.29)	20.69 (5.72)	16.35 (4.23)	4.81**	C > Ctl; IA = H/I = C
ANCOVA	19.61	20.03	19.96	17.68	0.67	No group differences
Mother- O/protect'n						
ANOVA	23.25 (5.10)	25.73 (6.15)	24.25 (5.34)	20.65 (4.80)	4.28*	H/I & C > Ctl; IA = H/I = C
ANCOVA	23.13	25.88	24.28	20.44	2.22	H/I & C > Ctl; IA = H/I = C;
Mother - Warmth						
ANOVA	43.72 (6.67)	45.82 (8.32)	42.10 (9.74)	47.76 (6.07)	3.57*	IA & C < Ctl; IA = H/I = C
ANCOVA	43.63	47.23	43.18	45.84	1.12	No group differences

Note: IA = inattention; H/I = hyperactivity-impulsivity; C = inattention and hyperactivity-impulsivity combined; Ctl = control; *** $p < .0001$; ** $p < .005$; * $p < .05$; ♦ All ANCOVA values equal the mean score after adjusting for the covariate

Table 25, also showed that there were group differences for mother warmth. Planned comparison tests showed no subtype differences, but the C subtype, and IA subtype had significantly lower mother warmth scores than the control group. Screening for ODD removed the group differences, thereby indicating that ODD has influenced the relation between the IA and C subtypes and control group.

Taken together, these results showed no subtype differences for each measure of child perception of parenting style. Mothers of each of the three subtypes were perceived by their children to be more rejecting and overprotective than mothers of control children. For maternal warmth, both the IA and C subtype mothers were perceived by their children to have less warmth than mothers of controls. For each of the parenting style measures, ODD did not influence differences among subtypes, but did influence relations between the subtypes and control group.

6 . 6 . 2 Teacher-derived dependent variables

6 . 6 . 2 . 1 Descriptive information

Table 26, shows the descriptive information for teacher ratings of inattention (IA), hyperactivity-impulsivity (H/I), oppositional defiant disorder (ODD), each of the three aggression style measures; proactive aggression (PAGG), covert aggression (CAGG), and reactive aggression (RAGG), and anxiety (ANX). The skewness values ranged between 1.77 (PAGG) to 1.16 (IA), while the kurtosis values ranged from 2.93 (PAGG) to -1.21 (H/I). None of the variables was significantly skewed or kurtotic.

Table 26

Descriptive Information for Teacher-derived Dependent Variables

Symptoms	Mean	*SD*	Skewness	Kurtosis
IA	13.78	7.66	-.16	-1.07
H/I	10.39	8.00	.31	-1.21
ODD	7.97	6.67	.41	-1.11
ANX	3.67	2.87	.69	-.02
PAGG	2.68	2.93	1.77	2.93
CAGG	3.14	3.33	1.22	2.15
RAGG	5.09	4.18	.46	-.86

Note: *SD* = Standard Deviation; IA = inattention; H/I = hyperactivity-impulsivity; ODD = Oppositional Defiant Disorder; ANX = anxiety; PAGG = proactive aggression; CAGG = covert aggression; RAGG = reactive aggression.

6.6.2.2 Inattention symptoms

The IA symptoms showed significant group differences (see Table 27). Planned comparison tests revealed that the IA and C subtypes had higher scores than the H/I subtype. There were no differences between the IA and C subtypes, and the three subtypes had higher inattention scores than the control group. After controlling for ODD there also were group differences, and planned comparison tests showed that both the IA and C subtypes had higher scores than the H/I subtype. These results suggested that ODD had no effect on the differences among the subtypes.

6 . 6 . 2 . 3 Hyperactivity-impulsivity symptoms

There were significant group differences (see Table 27). Planned comparison tests revealed that the subtypes had higher scores than controls, and H/I and C subtypes had higher scores than the IA subtype. After screening for ODD the group differences were unaltered, and this indicated that ODD did not influence the H/I scores.

6 . 6 . 2 . 4 ODD symptoms

Table 27, indicates that there were significant group differences. Planned comparison analysis indicated no differences between the subtypes, but each of the subtypes differed from controls.

6 . 6 . 2 . 5. Anxiety

Table 27, showed that there were significant group differences. Planned comparisons showed no differences between the subtypes, but the subtypes differed from controls. After controlling for ODD there were no group differences, indicating that ODD did influence the anxiety scores. Planned comparison analysis showed that only the IA subtype had higher scores than the control group. This result indicated that screening for ODD influences the relation between the IA group and control group.

Table 27

Group Comparisons of ADHD Subtypes and Normal Controls on Teacher-derived Measures

Variable	IA (n = 32)	H/I (n 11)	C (n =52)	Control (n =34)	F ratio	Significant group differences based on LSD planned comparison tests (p < .05)
IA symptoms						
ANOVA	17.25 (6.07)	11.55 (2.70)	17.46 (6.49)	5.36 (4.36)	36.28**	IA = C > H/I > Ctl
ANCOVA•	17.10	11.07	16.91	6.03	10.18*	IA = C > H/I > Ctl
H/I symptoms						
ANOVA	10.13 (6.55)	15.36 (7.43)	14.50 (7.38)	2.52 (2.90)	26.80**	C > IA; C = H/I; IA= H/I; IA & H/I & C > Ctl
ANCOVA	10.46	15.03	14.06	2.99	39.39**	H/I = C > IA = Ctl
ODD symptoms						
ANOVA	8.19 (6.00)	12.55 (5.89)	10.87 (6.27)	1.85 (2.98)	21.51**	IA = H/I = C > Ctl
Anxiety						
ANOVA	4.19 (2.87)	5.00 (2.72)	4.37 (2.91)	1.68 (1.80)	9.04*	IA = H/I = C > Ctl
ANCOVA	4.31	4.09	3.58	2.91	1.48	No group differences
Proactive aggression						
ANOVA	(2.67)	3.27 (2.53)	3.81 (3.38)	1.38 (1.67)	6.09*	C > IA & Ctl; C = H/I; IA = H/I = Ctl
ANCOVA	2.23	2.61	3.29	2.28	0.87	No group differences
Covert aggression						
ANOVA	(2.95)	3.18 (2.18)	4.50 (3.13)	1.21 (1.87)	10.04**	C > IA; C > Ctl; IA = H/I = Ctl
ANCOVA	3.10	2.53	3.94	2.09	2.04	C > Ctl; IA = H/I = Ctl; IA = H/I = C

Table 27, continued

Reactive aggression						
ANOVA	(3.72)	5.36 (2.29)	7.48 (4.08)	1.65 (2.50)	19.09**	C > IA; H/I = C; IA = H/I; IA & H/I & C > Ctl
ANCOVA	5.00	4.86	7.02	2.34	6.22*	C > IA; H/I = C; IA = H/I; IA & C > Ctl

Note: IA = inattention; H/I = hyperactivity/impulsivity; C = inattention and hyperactivity/impulsivity combined; Ctl = control; ** $p < .0001$, * $p < .05$; ♦ All ANCOVA values equal the mean score after adjusting for the covariate.

6 . 6 . 2 . 6 Aggression style

Table 27, shows the results for the three aggression style measures. There were significant group differences for proactive aggression. Planned comparisons demonstrated that the C subtype had higher proactive aggression scores than the IA subtype and control group, but there were no differences between the C and H/I groups. There was no difference between the H/I and C subtypes, or between IA and H/I subtype, and both the IA and H/I groups did not differ from controls. Screening for ODD removed the group differences, and this result indicated that ODD influenced proactive aggression scores, and in particular has inflated the differences between the IA and C subtypes.

For covert aggression, there were significant group differences. Planned comparisons revealed that the C subtype had significantly higher scores for covert aggression than the IA subtype, there were no differences between the C and H/I groups, but the three subtypes had higher covert aggression scores than the control group. Controlling for ODD removed the group differences, and this result suggests that the presence of ODD influenced the differences between the IA and C subtypes.

There were significant group differences for reactive aggression. Planned comparison tests indicated that the C subtype had significantly higher scores than the IA subtype. There were no differences between the C subtype and H/I subtypes, or between the C and H/I groups, or between the IA and H/I groups. The three subtypes had higher reactive aggression scores than the control group. After controlling for ODD there still were significant group differences, implying that ODD did not influence reactive aggression scores. However, planned comparisons showed that the C subtype had significantly higher reactive aggression scores than the IA subtype, and relations between the C and H/I subtype was approaching significance ($p < .066$) with the C subtype having substantially higher scores than the H/I subtype. This result suggests that while ODD may not influence overall group relations, ODD does influence relations among subtypes, because after screening for ODD the C subtype had higher reactive aggression scores than the IA and H/I subtypes, while there was no difference in relations between the IA and H/I subtypes.

Taken together, compared to the results reported above for the ANOVA, these results imply that ODD has an effect on the differences among the subtypes for proactive and covert aggression. By contrast, ODD appears to have no influence on reactive aggression.

6 . 6 . 3 Mother-derived dependent variables

6 . 6 . 3 . 1 Descriptive information

Table 28, shows the descriptive information for mother ratings of inattention (IA), hyperactivity-impulsivity (H/I), oppositional defiant disorder (ODD), each of the three aggression style measures; proactive aggression (PAGG), covert aggression (CAGG), and reactive aggression (RAGG), and anxiety (ANX). Skewness values ranged between 1.36 (GHQ depression) to -.89 (GHQ somatic), while kurtosis values ranged between 1.46 (GHQ social dysfunction) to –1.12 (H/I). None of the variables were significantly skewed or kurtotic.

Table 28

Descriptive information for Mother Derived Dependent Variables

Symptoms	Mean	*SD*	Skewness	Kurtosis
IA	16.41	7.39	-.51	-.65
H/I	13.82	8.07	-.18	-1.12
ODD	12.60	7.44	-.06	-1.05
ANX	5.54	4.13	.45	-.83
PAGG	4.20	3.21	.65	-.00
CAGG	4.72	3.33	.88	.44
RAGG	7.49	3.73	-.17	-.62
GHQ - Somatic	6.47	4.43	-.89	.60
GHQ - Anxiety	7.28	4.90	.53	-.23
GHQ - Social Dysfunction	7.60	2.92	.40	1.46
GHQ - Depression	3.07	4.02	1.36	.92

Note: *SD* = Standard Deviation; IA = inattention; H/I = hyperactivity-impulsivity; ODD = Oppositional Defiant Disorder; ANX = anxiety; PAGG = proactive aggression; CAGG = covert aggression; RAGG = reactive aggression; GHQ = general health questionnaire.

6.6.3.2 Inattention symptoms

As shown by Table 29, similar to teacher ratings, there were significant group differences. Planned comparisons showed that the IA and C subtypes had higher scores than the H/I subtype. There were no differences between the IA and C subtypes, and the subtypes had higher inattention scores than the control group.

After controlling for ODD the group differences remained unaltered. Compared to the results reported above for the ANOVA, this implies that ODD had no effect on the differences among the subtypes.

6 . 6 . 3 . 3 Hyperactivity-impulsivity symptoms

Similar to teacher ratings, there were significant group differences (see Table 29). Planned comparison tests revealed that the H/I and C subtypes had higher hyperactivity-impulsivity scores than the IA subtype. After controlling for ODD there also were group differences. Planned comparison analysis also showed the H/I and C subtypes differed significantly from the IA subtype, indicating that ODD does not influence group relations. Compared to those reported above for the ANOVA, the results imply that ODD had no effect on the differences among the groups.

6 . 6 . 3 . 4 ODD symptoms

Table 29, indicates, similar to teacher ratings, that there were significant group differences, and each of the subtypes had higher scores for ODD than the control group. However, unlike teacher ratings, there were differences among the subtypes. There were no differences between the H/I and C subtypes, but these subtypes had higher scores than the IA subtype.

Table 29

Group Comparisons of ADHD Subtypes and Normal Controls on Mother-derived Measures

Variable	IA (n = 32)	H/I (n 11)	C (n =52)	Control (n =34)	F ratio Between groups	Significant group differences based on LSD post hoc tests (p < .05)
IA symptoms						
ANOVA	19.90 (3.94)	12.18 (1.72)	21.43 (4.06)	7.03 (4.65)	97.83***	IA = C > H/I; IA & H/I & C > Ctl
ANCOVA♦	20.19	10.70	20.23	9.05	54.87***	IA = C > H/I; IA & H/I & C > Ctl
H/I symptoms						
ANOVA	10.29 (3.86)	19.64 (3.38)	20.86 (3.94)	4.59 (4.52)	126.10***	H/I = C > IA; IA & H/I & C > Ctl
ANCOVA	10.66	17.73	19.32	7.18	39.39***	H/I = C > IA; IA & H/I & C > Ctl
ODD symptoms						
ANOVA	11.42 (5.66)	18.64 (4.61)	17.49 (5.16)	4.38 (3.91)	53.88***	H/I = C > IA; H/I = C; IA & H/I & C > Ctl
Anxiety						
ANOVA	5.90 (4.53)	6.82 (3.82)	7.00 (3.99)	2.62 (2.28)	9.99***	IA = H/I = C > Ctl
ANCOVA	6.30	4.81	5.37	5.36	0.75	No group differences
Proactive aggression						
ANOVA	3.19 (2.72)	6.73 (2.90)	6.04 (2.75)	1.56 (1.78)	26.56***	H/I & C > IA; H/I = C; IA & H/I & C > Ctl
ANCOVA	4.47	5.29	4.88	3.51	2.54	H/I & C > IA; H/I = C; IA & H/I & C > Ctl
Covert aggression						
ANOVA	4.13 (2.91)	4.64 (1.69)	6.84 (3.29)	2.12 (1.80)	20.76***	C > IA; H/I = C; IA = H/I; IA = H/I = C > Ctl
ANCOVA	4.37	3.40	5.84	3.80	4.31**	C > IA & H/I & Ctl; IA = H/I = Ctl
Reactive aggression						
ANOVA	7.58 (2.88)	9.45 (2.21)	9.65 (2.86)	3.53 (2.67)	35.39***	C > IA; H/I = C; IA = H/I; IA = H/I = C > Ctl
ANCOVA	7.93	7.68	8.21	5.95	3.61*	IA & C .> Ctl ; IA = H/I = C

Table 29, continued

GHQ- Somatic						
ANOVA	6.81 (3.95)	7.09 (3.24)	7.53 (4.84)	4.38 (3.98)	3.86*	C > Ctl; IA = H/I = C
ANCOVA	7.08	5.70	6.41	6.27	0.37	No group differences
GHQ- Anxiety						
ANOVA	7.19 (4.64)	8.73 (5.26)	8.67 (4.83)	4.82 (4.30)	4.96**	H/I & C > Ctl; IA = H/I = C
ANCOVA	7.49	7.19	7.42	6.92	0.08	No group differences
GHQ- Social dysfunction						
ANOVA	7.65 (2.46)	8.55 (3.78)	8.41 (2.92)	6.03 (2.46)	5.50**	H/I & C > Ctl; IA = Ctl; IA = H/I = C
ANCOVA	7.80	7.74	7.76	7.13	0.27	No group differences
GHQ-Depression						
ANOVA	3.19 (3.80)	3.55 (5.63)	3.96 (4.26)	1.47 (2.73)	2.81*	C > Ctl; IA = H/I = C
ANCOVA	3.48	2.08	2.77	3.47	0.37	No group differences

Note: Values in brackets = standard deviation; IA = inattention; H/I = hyperactivity-impulsivity; C = inattention and hyperactivity-impulsivity combined; Ctl = control; *** $p < .0001$, ** $p < .005$; * $p < .05$; ♦All ANCOVA values equal the mean score after adjusting for the covariate.

6 . 6 . 3 . 5 Anxiety

Table 29 shows, similar to teacher ratings, that there were significant group differences, with each subtype having higher anxiety scores than the control group. After controlling for ODD there were no group differences indicating that ODD had a relatively equal influence on the scores for the three subtypes.

6 . 6 . 3 . 6 Aggression style

Table 29, shows the results for the three aggression style measures. There were significant group differences for proactive aggression. Planned comparison tests showed that the H/I and C subtypes had higher scores than the IA subtype. There were no differences between the H/I and C subtypes, and the three subtypes had higher scores than the control group. Screening for ODD removed the group differences, but the differences between the subtypes remained unaltered, with the H/I and C subtypes still having higher proactive aggression scores than the IA subtype. Compared to those reported above for the ANOVA, the results imply that the presence of ODD has not influenced proactive aggression scores among subtypes, but has reduced the differences between the subtypes and controls.

For covert aggression there were significant group differences. Planned comparison analysis demonstrated that the C subtype had higher scores than the IA subtype. There were no differences between the C and H/I subtypes, or between the IA and H/I subtypes, but each subtype had higher scores than controls. After controlling for ODD there still were significant group differences. Planned comparisons showed that the C subtype had higher scores than both the IA and H/I subtypes, and only the C subtype had higher covert aggression scores than the control group. Compared to those reported above for the ANOVA, the results imply that the presence of ODD has influenced differences among the subtypes. Although the differences between the C and IA subtypes was unaltered, the removal of ODD effects resulted in the C subtype having higher scores than both the IA and H/I subtypes, and only the C subtype had higher scores than the control group.

As shown in Table 29, there were significant group differences for reactive aggression. Planned comparisons revealed that the C subtype had significantly higher reactive aggression than the IA subtype, but there were no differences between C and H/I subtypes, or between the IA and H/I subtypes, and the subtypes had higher reactive aggression scores than the control group. After controlling for ODD there still were differences among the groups. However, planned comparison tests did not show subtype differences, rather the IA and C subtypes differed significantly from the control group. Compared to those reported above for the ANOVA, this result suggests that the effect of screening for ODD was to remove the differences among the subtypes, and remove the difference between the H/I group and controls.

Taken together, with, or without screening for ODD, the C subtype, and to a lesser extent the H/I subtype, had more overall aggression than the IA subtype. In particular, the C subtype had greater instrumental aggression (i.e., proactive and covert aggression) than the IA subtype. By contrast, for reactive aggression, while prior to screening for ODD the C subtype also had higher scores than the IA subtype, after screening for ODD there were no differences between the inattentive subtypes. Overall the results suggested that the C subtype is more associated with instrumental aggression and ODD type behaviours, whereas there are no distinctions between the subtypes for the non-instrumental reactive aggression.

6.6.3.7 General health status

As shown in Table 29, for the somatic subscale there were significant group differences. Planned comparison analysis showed no significant differences among the subtypes, but the C subtype had higher scores than the control group. After screening for ODD there were no significant group differences. For the anxiety subscale, the groups differed significantly. There were no subtype differences, and the C subtype had significantly higher scores than controls. Screening for ODD removed the group differences. The social dysfunction subscale also showed significant group differences. Planned comparisons revealed no subtype differences, and the C and H/I subtypes differed significantly from the control group. After controlling for ODD the group differences were no longer apparent. Finally, the depression subscale also showed significant group differences. Planned comparisons found only the C subtype differed significantly from the control group, and there were no significant subtype differences. Similar to the other subscales, screening for ODD removed the group differences.

Taken together, there were no subtype differences for any of the mental health subscales. The effect of screening for ODD removed the differences between the subtypes and control group. Overall, these results suggested that the presence of ODD inflated the differences between the C subtype and control group for each subscale.

6 . 7 Discussion

For the majority of the variables the results were generally as expected with the control group having significantly lower problem scores than the subtypes, especially the C subtype. It was interesting that while controlling for ODD attenuated the differences between the subtypes and control group, the C subtype still differed more from the control group than the IA and H/I subtypes. Given the main purpose of this study, the discussion will focus on differences among the subtypes.

Taken together, although there were few significant differences among subtypes, in line with broad expectation, the findings across a diverse range of variables implied that hyperactivity-impulsivity may be more associated with externalising problem behaviour than inattention. Generally, the subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes) had higher scores for externalising variables (ODD, aggression style, SIP, parent rejection, and parent overprotection) than the subtype with inattention per se (i.e., IA subtype). In addition, comparison between the two hyperactive-impulsive subtypes clearly showed that the C subtype had higher problem scores than the H/I subtype for most measures.

By contrast for the variables IQ, academic functioning, and anxiety, the findings were contrary to broad expectation, as there were no subtype differences except for the reading subtest in academic functioning. In addition the lack of distinction among subtypes for the overall scores of these variables further implied that there might be difficulty differentiating the subtypes for IQ, academic functioning and anxiety.

To maintain consistency, the discussion of the dependent variables is examined in the following order: child-derived variables, teacher-mother variables, and then the mother only variable.

6.7.1 Child-derived dependent variables

6.7.1.1 IQ and academic functioning

The lack of subtype differences for IQ, and academic functioning was relatively consistent with past findings (Faraone et al., 1998; Lahey et al., 1998; McBurnett et al., 1999; Paternite et al., 1996; Vaughn et al., 1997; Wheeler & Carlson, 2000). The handful of studies comparing the three subtypes generally have found few differences among the groups, although a few studies indicated the H/I subtype to have higher IQ than the IA and C subtypes. Overall, the results imply that hyperactive-impulsive only children have higher IQ than children with inattention, or children with inattention and hyperactivity-impulsivity. Perhaps related to this, the H/I subtype also appeared to have higher overall academic functioning than the subtypes with inattention problems (ie., IA and C subtypes). There also appeared a lack of clear distinction between the inattention subtypes for different aspects of academic functioning. For instance, contrary to previous findings, the C subtype had lower reading scores than the IA subtype. However the expectation that the IA subtype would have lower maths scores than the C subtype was not fulfilled.

Taken overall, these results were generally consistent with past findings where few reliable distinctions emerged between the subtypes with inattention (ie., IA and C subtypes), and similar to past findings, the H/I subtype had higher IQ and academic functioning than the IA and C subtypes.

6.7.1.2 Social information processing

The results for the SIP measures were contrary to expectation. Although no subtype studies have been conducted, the expectation was generally in line with past findings that have implicated the dimension of hyperactivity-impulsivity with increased aggression, hostile intent, response selection, and emotional reactivity (Amin et al., 1993; Dodge & Coie, 1987; Grenell et al., 1987; Lemerise & Arsenio, 2000; Milich & Dodge, 1984). However, with, or without screening for ODD, the expected differences between the subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes), and the inattentive subtype (i.e., IA subtype) were not found. While the H/I and C subtypes had higher scores than the IA subtype for each measure, these differences were not significant.

The findings of a very recent study might provide an explanation for the lack of distinction among the subtypes for the SIP measures. Although past studies have implicated hyperactivity-impulsivity rather than inattention with increased hostile biased social cognitions, none of these studies actually examined ADHD diagnosed children. Very recently, Gomez and Gomez (2003), while not specifically examining ADHD subtypes, did obtain a sample of comorbid ADHD and ODD children to examine the mediating effect of hostile biased social cognitions upon perceived maternal parenting styles and disruptive behaviours of ADHD/ODD children. Their findings suggested that hostile biased social cognitions are primarily associated with ODD as a function of problematic parenting. This implies that ADHD and ODD are independent disorders.

6.7.1.3 Maternal parenting style

The expectation that both subtypes with hyperactivity-impulsivity would have a more problematic parenting style (i.e., increased rejection and overprotection scores) than the subtype with inattention was not fulfilled. Prior to screening for ODD, findings showed no subtype differences, and any group differences pertained mainly to relations between the C subtype and controls. Controlling for ODD generally removed the group differences. Given that the few past studies (Faraone et al., 1998; Paternite et al., 1996) have not shown consistent subtype distinctions for parenting variables, these results have supported more recent findings that ADHD is independent of parenting style, with problematic parenting being more associated with ODD and conduct problems (Gomez & Gomez, 2003).

6.7.2 Teacher and mother-derived dependent variables

6.7.2.1 ADHD symptoms

As expected, the results clearly showed that, for both teacher and mother data, the inattention symptoms were strongly associated with the subtypes with inattention (i.e., IA and C subtypes), whereas the hyperactivity-impulsivity symptoms were strongly associated with the subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes). That screening for ODD did not alter these relationships endorsed the independence of the respective dimensions of ADHD.

6.7.2.2 ODD symptoms

Although for teacher data the scores were in the direction as expected with the H/I and C subtypes having higher scores for ODD than the IA subtype, contrary to expectation, there were no significant differences between the subtypes. For mother data, the expected association between hyperactivity-impulsivity and ODD was found, with both ADHD subtypes with hyperactivity-impulsivity (i.e., H/I and C subtypes) demonstrating higher levels of ODD than the ADHD subtype with inattention (i.e., IA subtype). As previously shown in Table 28, mother ratings showed a high comorbidity between the hyperactive-impulsive subtypes and ODD, whereas teacher ratings showed a reduced association between the hyperactive-impulsive subtypes and ODD. Nevertheless, taken overall both subtypes with hyperactivity-impulsivity appeared to be more associated with ODD than the subtype with inattention per se.

6 . 7 . 2 . 3. Anxiety

Contrary to expectation and past findings (see Gaub & Carlson, 1997a; Lahey et al., 1984; Nolan et al., 2001; Ostrander et al., 1998), with, or without screening for ODD, the results for anxiety produced no differences among the subtypes. Thus the expectation that the inattentive subtypes (i.e., IA and C subtypes) would have greater anxiety than the hyperactive-impulsive subtype (i.e., H/I subtype) was not fulfilled. Indeed it was interesting that not only were there no differences among the subtypes, but also there were no distinctions between the subtypes and control group. The overall results tend to suggest that ODD has no influence on anxiety, and the separate dimensions of inattention, and hyperactivity-impulsivity differentially endow a similar risk for anxiety.

6 . 7 . 2 . 4. Aggression style

With respect to aggression style, prior to screening for ODD, for all teacher and mother aggression scores, the C subtype had higher scores than the IA subtype. Given past findings of little or no association between IA and any type of aggression, and the strong association between the C subtype and different aggressive behaviours, these findings were in line with expectation.

As previously noted, past studies have shown that the link between ADHD and aggression is related to impulse-control deficits that characterise the subtypes with hyperactivity-impulsivity rather than inattention. Based on a long line of research by Dodge and colleagues (Dodge, 1980; Dodge & Coie, 1987; Dodge & Frame, 1982; Dodge et al., 1995; Dodge et al., 1997), it appears that the impulse control deficits of hyperactive-impulsive ADHD children are more likely to be associated with spontaneous and unplanned aggression such as that represented by a reactive aggression style.

By contrast, the deliberate, planned and instrumental aggression style represented by proactive and covert aggression is more likely to be associated with social-environmental factors (especially problematic parenting) precursive of ODD/CD behaviours (see Coy et al., 2001; Gomez & Gomez, 2000, 2003; Gomez et al., 2001). As such it was not surprising that, for both teacher and mother ratings, for the two subtypes with impulse-control deficits (i.e., H/I and C subtypes), reactive aggression scores were somewhat higher than proactive and covert aggression scores. However, for both teacher and mother data, prior to screening for ODD, of the two hyperactive-impulsive subtypes, only the C subtype had significantly higher reactive aggression scores than the IA subtype.

After screening for ODD the lack of agreement between teacher and mother data, makes it difficult to draw meaningful inferences about differences among subtypes for reactive aggression. For instance, both teacher and mother ratings indicated that ODD had no overall influence on group relations, however, with respect to subtype differences, planned comparison analysis of teacher ratings showed the C subtype to have greater reactive aggression than the IA subtype, whereas mother ratings showed no subtype differences. Such a result suggests that alternatively, the presence of ODD appears to clarify distinctions between the C and IA subtypes, or that ODD may be relatively independent of reactive aggression.

Notwithstanding the obvious difficulties in interpreting subtype differences imposed by the inconsistencies between teacher and mother data, it was clear that, overall, screening for ODD reduced the differences among the subtypes. While it is difficult to evaluate the contribution of ODD upon the differences among the subtypes, it seems that of the two subtypes with hyperactivity-impulsivity, the combined subtype, marginally more than the H/I subtype, is associated with the two instrumental aggression forms, proactive and covert aggression. Taken together, the scores for the different aggression style measures, with, and without controlling for ODD revealed relatively few differences among subtypes.

These results tend to suggest that ODD has only a minimal influence on aggression style. Moreover, while past findings generally have found both hyperactive-impulsive subtypes (i.e., H/I and C subtypes) to be relatively equally associated with greater aggression than the inattentive subtype (i.e., IA subtype), the findings in this study indicate that the combined effects of inattention and hyperactivity-impulsivity imbue the C subtype with marginally more aggression, irrespective of aggression style, than the H/I subtype, which also has higher overall aggression than the IA subtype.

In addition, with respect to the differences in findings between this study and past studies, it should be noted that almost all past studies used aggression ratings derived from global behavioural rating scales (i.e., Conners, CBCL, and BASC), rather than scales developed to specifically measure different types of aggression, as applies in this study.

6.7.3 Mother-derived dependent variable

6.7.3.1 General health status

With, or without controlling for ODD, mother perceived general health status showed no subtype differences for any of the somatic, anxiety, social dysfunction, and depression subscales. Taken overall, the results tend to suggest only very minimal differences among subtypes. Given that to date the only past study (Gadow et al., 2000) examining relations between maternal general health and ADHD subtypes found relatively few subtype differences, it is clear that many more studies will be needed to clarify this issue.

6.8 Conclusion

In conclusion, the findings in this study are important because this is the one of the very studies to show the differences among subtypes, with, and without controlling for ODD across a broad range of variables. For the majority of the subtype comparisons there were relatively few differences in results when both conditions were compared. That is, the presence, or non-presence of ODD did not substantially alter the relations among the subtypes. However, when the presence of ODD did influence subtype differences, the effect was almost exclusively related to reducing the magnitude of difference between the C subtype and the IA subtype. For instance, without screening for ODD, aggression style showed significant group differences between the C subtype and IA subtype for all measures except teacher ratings of covert aggression. Taken overall, these results are especially important because they show that for most variables ODD did not influence group relations, and when ODD did influence group relations, ODD was almost exclusively associated with elevations in scores for the C subtype.

In summary, this study has provided findings generally supportive of many results in past studies. For both teacher and mother data, for those variables that have been examined in past subtype studies, the findings were generally quite consistent. In broad terms, the findings for teacher and mother ratings of the ADHD symptoms confirmed the dichotomy between the inattention and hyperactivity-impulsivity dimensions for the DSM-IV structure of ADHD. However, somewhat surprisingly there was a lack of agreement between informants for the ODD symptoms.

An explanation for this unexpected discrepancy between teacher and mother data possibly lies in the critical influence of situational context. For instance teachers may be influenced by the moderating effects of a school environment, together with the undoubted long-term effects of medication, given that the large majority of ADHD children in this study have been on medication for at least two years. Moreover, mother data generally reflecting only a single and subjective behavioural observation, is more likely to lack the benefit of comparison with other different types of ADHD children such as applies to teachers. In addition, ADHD mothers are more likely to observe their children without medication, and to be influenced by past memories of their child's ADHD behaviours, and hence less likely to reflect a more objective and balanced view of specific ADHD behaviours such as teachers may be likely to represent.

The results for academic functioning, and anxiety were contrary to the stated hypotheses. Nevertheless, as previously noted, given the mixed results for these variables in several past studies, the overall results were not entirely unexpected. In particular, the lack of distinction between the IA and C subtypes was consistent with the findings in several past studies.

The results for those variables hitherto not examined with subtypes (i.e., SIP, aggression style, maternal parenting style, and maternal mental health) were also contrary to expectation. Given that none of these variables has been examined as subtypes, and the fact that the hypotheses for these variables were framed primarily on findings related to groups of aggressive-hyperactive children rather than ADHD children, the results in this study suggest that aggressive-hyperactive children are probably more representative of comorbid ADHD-ODD rather than ADHD.

However, standing as a possible contradiction to this argument, was the high ODD comorbidity between the H/I and C subtypes. Given the lack of association between the IA subtype and ODD, and substantial association between the H/I and C subtypes documented in past studies, this line of reasoning therefore suggests that comorbid H/I and C subtypes should differ from the IA subtype, and have higher scores for these externalising variables. Yet the results in the current study have shown no differences among subtypes for these variables. A possible explanation for this seeming contradiction has been provided by two recent studies (Coy et al., 2001; Gomez & Gomez, 2003). As previously noted, these studies have shown the mediational role of aggression upon oppositional behaviour, hostile SIP, and problematic parenting, as well as the independence of ADHD from aggression. In addition both studies indicated that increased aggression in ADHD children was directly related to comorbidity with ODD.

Moreover, there may be a further factor whose effect should not be underestimated in obfuscating distinctions among subtypes. For this sample of diagnosed ADHD children, based on the data, and informal interviews with parents, it appears most likely that the combined effects of long-term psychosocial interventions and medication may have substantially minimised the more problematic effects of the hyperactive-impulsive dimensions of ADHD. For instance as part of this process, child-parent reciprocal effects would make it more likely that the ADHD child and his/her parent's perceptions, attitudes, and actions would be less negative and more positive in the areas of social cognition, aggression, and general overall behaviour. Such an effect stands in juxtaposition to the findings for groups of clinically referred hyperactive-impulsive ADHD children in many other studies, where ODD was not screened, and as well where it appears quite unlikely that the hyperactive-impulsive children had received the types of intervention programs that appear to have prevailed for the ADHD subtypes in this study

In conclusion, despite the overall lack of distinction among the subtypes, the most critical finding in this study was that the C subtype, the subtype with the combined dimensions of inattention and hyperactivity-impulsivity, had greater impairment across more variables than the either of the separate dimensions of inattention (i.e., IA subtype) or hyperactivity-impulsivity (i.e., H/I subtype).

In addition, and very importantly, the design of this study has extended our understanding of the differences between the ADHD subtypes by taking into account the effects of ODD. It has more clearly shown that, as an organic disorder ADHD per se is a construct that is relatively independent from the social-environmental factors that shape and influence the development of ODD, aggression, hostile-biased social cognitions, and problematic child-parent interactions. Thus the findings in this study, by demonstrating the relative independence of ADHD, have provided greater clarity of the differences among DSM-IV ADHD subtypes for the range of measures examined.

CHAPTER 7

GENERAL DISCUSSION AND CONCLUSIONS

7 . 1 Introduction

In this chapter the implications of the two construct validity studies undertaken in this thesis will be discussed in relation to several critical issues surrounding ADHD. Study 1 examined the internal validity of the DSM-IV ADHD symptom organisation. Among the issues discussed will be implications for the structural organisation and conceptualisation of the disorder, implications of source effects for teacher and parent ratings and the psychometric properties of ADHD rating scales, as well as assessment and treatment options for ADHD children. Study 2 examined the external validity of the ADHD subtypes. Among the issues discussed will be implications of differences among the subtypes and implications for the validity of the ADHD subtypes. Relevant to all the above issues, and also to the interpretation of results is how the data reported in the current studies compare to those reported in previous studies.

Study 1, the internal validity of DSM-IV ADHD will be examined first. This study had two principal aims. The first aim was to use EFA and CFA procedures to examine the structural organisation of the DSM-IV ADHD symptoms. The second aim was to use CFA procedures to model a MTMS design to examine the construct validity of the DSM-IV ADHD rating scale.

7 . 2 Exploratory and confirmatory factor analysis of the structural organisation of teacher and parent ratings of DSM-IV ADHD symptoms

The first aim of this study was to use EFA and CFA to examine the factor structure of the DSM-IV ADHD symptoms. As discussed in chapter 2, ADHD has undergone considerable change in diagnostic terminology and criteria mainly because the conceptualisation of the core deficits of IA, HYP, and IMP has evolved over time. In the light of the significant reconceptualisation of ADHD over the past three DSM editions the current study examined the organisation of the DSM-IV ADHD symptoms based on a comparison of the factor structure within the past three DSM's. In DSM-III the disorder was titled "Attention Deficit Disorder", and was conceptualised as comprising three separate dimensions, IA, HYP, and IMP. In DSM-III-R the disorder was radically reconceptualised as a unidimensional construct known as "Attention Deficit Hyperactivity Disorder". DSM-IV retained the title "Attention Deficit Hyperactivity Disorder", however the separate dimensions of IA, HYP, and IMP were regrouped to form two dimensions of IA and H/I.

7 . 2 . 1 Testing the factor structure of the DSM-IV ADHD symptoms using EFA and CFA procedures

The EFA and CFA procedures in this study generally confirmed the two-factor structure of the ADHD symptoms proposed in DSM-IV. The results of the EFA provided a structure proximal to the current DSM-IV organisation.

Teacher ratings provided support for a two-factor structure comprising separate IA and H/I factors, whereas parent ratings generally supported a three-factor structure comprising the separate dimensions of IA, HYP, and IMP.

However the strong correlation between the HYP and IMP factors indicated that these factors are very closely related. Thus, the findings for teacher and parent ratings can be taken as providing support for the way the ADHD symptoms are organised in DSM-IV. Taken overall, the findings were consistent with the data in past studies based on DSM-IV ADHD criteria, using both normative samples (DuPaul et al., 1997, 1998; Holland et al., 1998; Hudziak et al., 1998; Rohde et al., 1998; Weiler et al., 1999; Yang et al., 2000), and clinic samples (McBurnett et al., 2001; Wolraich et al., 1998).

For the CFA three models were compared; a single-factor model proximal to DSM-III-R, a two-factor model proximal to the current DSM-IV structure, and a three-factor model proximal to DSM-III. Results of the CFA showed relatively minimal differences between the two- and three-factor models, and both the 2 and 3 factor models provided a superior fit to the 1 factor model. These results were consistent with past findings using both clinical and normative samples (Burns et al., 2001; DuPaul et al., 1997, 1998; Gomez et al., 1999; Molina et al., 2001: Pillow et al., 1998).

Given that the results of this study found high correlation between the HYP and IMP symptoms in the three-factor model, also found in past studies (Gomez et al., 1999), it can be argued that the current DSM-IV two-factor model is an appropriate organisation of the ADHD symptoms. CFA parcel analysis of a model based on the DSM-IV two-factor structure also showed an excellent fit to the data. In addition, composite reliability and variance extraction tests supported the internal consistency of the DSM-IV representation of the IA and H/I dimensions. Taken together, the overall results have supported the DSM-IV organisation of the ADHD symptoms. As no previous study has used CFA with

ADHD only children to examine the structure of the ADHD symptoms, the results here extend existing data, and provide stronger confirmation of the DSM-IV conceptualisation of how the ADHD symptoms are grouped.

7 . 3 Trait, source and error variance in the ADHD symptoms: Examining construct validity using CFA MTMS procedures

The study also used correlated-trait-correlated source CFA procedures to model an MTMS source design to examine the construct validity of teacher and parent ADHD rating scales. Given the critical usage of rating scales for the diagnosis of ADHD, it is paramount to know the amount of trait, source, and error variance in these scales.

7 . 3 . 1 Testing for convergent and discriminant validity of the ADHD symptom parcels

At the matrix level there was support for the convergent validity of the traits and discriminant validity of the traits and sources. However, in general the individual parcel level is thought to provide a stronger test of the convergent and discriminant validities of a construct than the matrix level. The results at the individual parcel level showed stronger trait than source effects for teacher H/I compared with parent H/I, and stronger trait than source effects for parent H/I compared with teacher H/I. Thus the findings at the individual parcel level questioned the results at the matrix level, and the results are better interpreted as providing support for the convergent validity of the teacher rated H/I symptoms and parent rated IA symptoms. These results are generally quite consistent with the data in previous studies (Burns et al., in press; Gomez et al., 2003).

7 . 4 Implications of source effects in ADHD rating scales

As previously noted, the presence of strong source effects is consistent with past ADHD data (Burns et al., in press; Gomez et al., 2003; Gomez, Burns, Keogh et al., in press). In addition, the presence of strong source effects in the current study of ADHD is also consistent with other MTMS studies of childhood behaviour in which considerable source variance in childhood behaviour rating scales has been reported (Byrne & Bazana, 1996; Epkins & Meyers, 1994; Fergusson & Horwood, 1989; Hewitt et al., 1992). For instance, Hewitt et al. (1992) found source variance accounted for 1% to 48% of the variance in parental ratings of the CBCL. Fergusson and Horwood (1989) found 60% to 72% of the variance for teacher and parent ratings of conduct disorder was attributable to source or error variance. A study of social and academic competencies (Byrne & Bazana, 1996) based on teacher, parent, self, and peer ratings of grade three children, found that source variance exceeded trait variance for 15 of the 16 variables used. Similarly, teacher, parent, self, and peer report in a study of childhood depression, anxiety, and aggression (Epkins & Meyers, 1994), found source variance was more than double the trait variance of the different measures.

The shared pattern of findings between the current study and past studies for childhood behaviour imply several possibilities for the interpretation of the data in the current study. First, the strong source effects represent an accurate view and are indicative of real differences as a function of the different perspectives of teachers and parents. Second, the strong source effects represent a method bias of the raters. Third, the strong source effects represent an amalgam between accuracy and bias of the raters. Fourth, the strong source effects imply problems with the conceptualisation of the DSM-IV ADHD symptoms (and the psychometric properties of any rating scales based directly on these symptoms). The implications of each of these possibilities are discussed below.

7.4.1 Implications of source effects as an accurate view of teacher and parent ratings

The strong source effects may indicate that the IA and H/I traits are not being presented consistently across different settings, or are not being conceived in the same manner across the school or home environment. Thus this interpretation implies that the strong source effects are the result of accurate but dissimilar views within the different raters. For instance, Greenbaum et al. (1994) has suggested that a child's behaviour may be compliant at home, but at school it may be defiant and unruly. Thus "these two different sources of systematic method variance (ie., artifact vs. true situational differences) produce similar correlations among the uniquenesses", and "these effects although distinct conceptually, are difficult to separate empirically" (p.145).

The view that source effects represent meaningful constructs as real differences in children's behaviour across raters has been endorsed by several researchers (Dishion, Burraston, & Li, in press; Dishion & Patterson, 1999; Greenbaum, Dedrick, Prange, & Friedman, 1994). In Dishion et al's (in press) study the trait factors (parenting constructs) and the source factors (parent, child, and staff) have both predicted the outcome measures of authority conflict and drug use with some of the prediction even stronger for the source factors. The ability of the source effects to predict the outcome measures allowed Dishion et al. to predict that source effects can represent "theoretically meaningful" variance.

7.4.2 Implications of source effects as a bias view of teacher and parent ratings

Source effects may represent bias, with the rating of different kinds of behaviour in different settings being substantially determined by the individual characteristics of each rater. Thus, the different knowledge, beliefs, values, and skills of each informant may bias their ratings. Alternatively, it may be that there is a strong source effect because the content of the different items is not appropriate to the situation of the rater (Burns, Gomez, Walsh et al., 2003). For instance, the level of symptom occurrence at school may influence parent ratings of IA, and the level of inattentive behaviour in the home setting may influence teacher ratings.

7.4.3 Implications of source effects as a bias and accuracy view of teacher and parent ratings

At the present time there is no way to empirically distinguish between the bias and accuracy view of source effects (Greenbaum et al., 1994). To date only one study has examined this perspective of the ADHD symptoms (Burns et al., in press). As previously discussed (see chapter 4), this study examined the convergent and discriminant validity of teacher and parent ratings of the ADHD symptoms across a three month interval using a CFA MTMS design. Results indicated the presence of strong source effects. Indeed, the findings that similar traits and similar sources were more strongly correlated across time than dissimilar traits and dissimilar sources, implied that the source effects were more likely to be consistent with the bias versus accuracy view.

7 . 4 . 4 Implications of source effects for the psychometric properties of ADHD rating scales

ADHD rating scales have been presumed to provide objective information about symptoms of the disorder. However while rating scales are designed to reflect the true behaviour of ADHD children (trait variance), they inadvertently also reflect the characteristics of the rater (source variance). Burns et al. (2003) believe that because source effects can represent bias it is necessary to minimise the influence of source effects so as to increase the content validity of the respective rating scales. They have identified wording of the ADHD symptoms on the rating scales, instructions to teachers and parents about how to complete the rating scales, and cutoff scores related to rating anchors, and frequency and impairment criterion for the symptoms, as key elements that contribute to source effects.

For instance, they have suggested that the content of the different items may not be appropriate to the situation of the rater. As an example the item "often leaves seat in classroom or in other situations in which seating is expected" takes on an entirely different perspective for teachers than parents. The authors have indicated that to eliminate this problem the wording of each symptom needs to have rater-specific content. That is, for items referring to home behaviour the content should be home-specific, items referring to school behaviour should be school-specific.

The reduction of source effects and concomitant improvement in the psychometric properties of ADHD rating scales may also be related to improvements in the process to determine cut off scores. Past studies have generally used 4-point rating scales ranging from 0 to 3, and a rating of 2 has been taken to indicate the presence of a symptom (DuPaul, 1997, 1998; Gomez et al., 1999; Weiler et al., 1999). However other scales such as the Conners Parent Rating Scale (Conners, Sitarenios, Parker, & Epstein, 1998a), and the Conners Teacher Rating Scale (Conners, Sitarenios, Parker, & Epstein, 1998b), require a more stringent rating of 3 for a symptom to be considered present.

Given the discrepancy between cut offs adopted by different classification experts, multitrait-multisource studies could be conducted to ascertain the cut off scores to reflect the presence of the ADHD symptoms. Thus multitrait (eg., IA, H/I), multisource (eg., teachers, parents), multilevel (eg., ratings of 1, 2, and 3), frequency of occurrence criterion (eg., times in past week, months), and specific diagnostic criterion (eg., rating scales, diagnostic interviews, direct observation) could be conducted to determine which cut off scores reflect the presence or non presence of the ADHD symptoms. The cut off score that provides the highest trait variance, and lowest source, and error variance would be the desired score. Such a process should improve the content validity of the rating scale and thereby substantially minimise source effects.

In summary, implicit in the discussion of source effects above, are questions about the overall validity of ADHD rating scales to establish the structural organisation of the ADHD symptoms. It has been argued that the strong source effects found in the current and previous studies may be related to shortcomings with the psychometric properties of the ADHD rating scale. Given this, this implies the need to exercise caution when interpreting the structural organisation of the ADHD symptoms on the basis of rating scales only.

7.4.5 Implications of source effects for the conceptualisation of ADHD

The source effects may also be related to problems with the DSM-IV conceptualisation of ADHD. To date all teacher and parent ratings of the ADHD symptoms using similar rating scales have shown the same pattern of results with a teacher H/I trait effect, and a parent IA trait effect. That the source effects in the normative samples applied across cultures to both Australian and Brazilian school children points to problems with the DSM-IV conceptualisation of ADHD. In addition there were strong source effects in the current study of ADHD children. Given that trait effects should be higher in ADHD children (DuPaul, 2003) the strong source effects further endorsed the prospect of problems with the conceptualisation of ADHD.

Given the overall results to date for ADHD rating scales, it may be that source specific criteria may be more appropriate for diagnostic purposes. Thus the symptoms for H/I would apply to the school setting, whereas the symptoms for IA would apply to the home setting. Nevertheless, the current use of single sources within each setting (ie., teacher ratings for school settings and parent ratings for home settings) precludes further evaluation of this issue. To test whether possible flaws in the current DSM-IV cross-situational criteria for ADHD have contributed to source effects future CFA MTMS designs need to include multiple source factors in each home or school setting. For instance in the school setting multiple raters could include classroom teacher, grade coordinator, specialist teacher, and teacher aide, and within the home setting multiple raters could include mother, father, sibling, other close blood relative, and neighbour. Such designs might yield more trait variance and less source variance because there are now more raters within the same setting.

To date this type of design has not been tested, although Rowe and Kandel (1997) using mother and father ratings of the CBCL found substantially more trait than source variance for mother ratings (42% vs. 26%) and father ratings (58% vs. 21%) of the externalising symptoms, but for the internalising symptoms only the mother had marginally higher trait than source variance (51% vs. 45%). It is speculated that if future studies were to show that multiple ratings in the same setting resulted in source effects then such a result would suggest that the source effects reflect mostly bias. Moreover, if more trait than source variance occurs for the ADHD symptoms using such a rating system, then the problem would appear to be more with the conceptualisation of ADHD as a stable trait across situations rather than a problem with the rating scales.

7.5 Implications for the assessment of ADHD

The results of the current study support multisource (i.e., teachers, parents, clinicians), same setting assessment of ADHD. With respect to diagnostic decisions in general, DuPaul (2003), has suggested that reliance on a single source (i.e., teacher or parent) could lead to erroneous diagnostic conclusions that will in turn affect clinical outcomes. In addition, if the current findings are an accurate representation of the relative differences between teacher and parent perceptions, then the findings cast considerable doubt over the cornerstone cross-situational conceptualisation of ADHD. Such findings fly in the face of traditional sentiment that multiple cross-situational criteria are necessary to accurately perceive the presence of ADHD symptoms in children (Hutchinson et al., 2001; Jensen et al., 1999; Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000). Given this, it is suggested that greater emphasis should be placed on the IA and H/I dimensions as a function of setting. For instance, based on the current findings IA was more evident in the home setting, and H/I in the school setting. These findings suggest that IA diagnosis should be primarily based on home setting.

Thus diagnosis and assessment of inattention could be as follows. The first stage should include a history of the child's behaviour, including related family history, and other medical, developmental and school information provided by the child's parents. As part of this process parents should complete a comprehensive battery of appropriate rating scales for inattention behaviours, and any other rating scales with symptoms known to be co-related with inattention behaviours.

The second stage should include a comprehensive assessment of the child's behaviour at school. The main purpose of the school ratings of the IA behaviours would be to confirm the scope and severity of the IA symptoms, especially to what degree the inattention behaviour impacts upon school performance and behaviour. Finally, based mainly on diagnostic protocols pertinent to the home setting, and to a lesser degree the agreement or discrepancy between parent and school ratings, treatment programs could be established to deal with the inattention behaviour as a function of the specific needs of the respective settings.

7 . 6 Implications for the treatment of ADHD

With respect to treatment, the strong trait effects for parent IA imply that parents should be more directly involved in treatment programs to deal with the inattention problems of their children. It is suggested that the parent IA trait effect may indicate that inattention problems substantially interfere with parental management of the inattentive ADHD child. Thus given the range of inattention effects, parents may need specialised training to deal with the impact of inattention upon the child's self-esteem, anxiety, frustration levels, learning capacity, and peer and social relations. For instance, clinicians could provide parents with appropriate strategies to manage inattentive behaviour. Parents could be trained in techniques such as response cost and reward, and strategies for maximising on task behaviour.

Similarly, the finding of a strong H/I trait effect for teachers implies that hyperactivity-impulsivity is more likely to occur at school. This result suggests that teachers should be more directly involved in the treatment of hyperactive-impulsive behaviours. The use of teacher training, and specialised school-based programs may be warranted with these children. Given the often emotional and behavioural problems associated with hyperactive-impulsive children, school-based interventions might range between school and classroom monitoring of behaviour, specialised support for the classroom teacher, and time spent in specialised classroom settings. For instance clinicians could provide school-based interventions, as individualised or group procedures, for teachers and children in such areas as anger management, conflict resolution, and self-esteem and social skills enhancement.

7 . 7 Strengths and limitations of Study 1

The importance of this study is that, to the author's knowledge it is the first study to use standard CFA procedures to examine the construct validity of the DSM-IV organisation of ADHD with a sample of diagnosed ADHD children. In addition it is the first study to use a CFA MTMS approach to examine the trait, source, and error variance of the ADHD symptoms with diagnosed ADHD children using teacher and parent ratings. As such it is the first study to provide a clearer test of the internal validity of the structural organisation and dimensions of DSM-IV ADHD using a CFA MTMS approach. Unlike previous studies where the use of normative samples may limit the generalisability of the results, this study used a sample of diagnosed ADHD children. Therefore, it seems reasonable to suggest that the trait and source effects found in this study are likely to be more representative because the results are derivative from rating scales based on the characteristic behaviours of the ADHD children in this study.

Limitations should also be acknowledged in the interpretation of the results of this study. The CFA MTMS analyses were conducted at the symptom parcel level. This precluded assessment of the trait, source, and error variance at the individual symptom level (ie., the trait, source, and error variance of the individual ADHD symptoms). As well, the current study could not resolve the issue of whether the source effects represent bias, or accurate depictions of the child's behaviour as a function of different settings. As previously discussed, CFA MTMS longitudinal studies of the ADHD symptoms, and the use of multiple sources (ie., parents, relatives, friends, and school personnel, clinicians) and multiple methods (ie., diagnostic interviews, direct observation, rating scales) may address this issue.

7 . 8 Study 2: External validity of DSM-IV ADHD subtypes

This study was designed to investigate differences among ADHD subtypes, and between the ADHD subtypes and control children, with and without controlling for the influence of ODD, and in so doing examined the external validity of the ADHD subtypes. Table 30 shows a summary of the results for the differences among subtypes.

Prior to the discussion, it should be stated that the hypotheses were formulated solely upon a summation of the findings of past DSM-IV subtype studies involving the three subtypes. As shown by Table 20, there are very few previous studies comparing the three subtypes for the majority of the different variables (ie., IQ, anxiety, academic functioning, maternal mental health) examined in this study, and the results in the current study should be considered in the light of this information. In addition (as shown in chapter 5) very few studies controlled for ODD, and the results from those studies that did control for ODD do not provide sufficient information to further clarify relations among subtypes

7 . 8 . 1 Implications of differences among subtypes

Close perusal of Table 20 shows very few differences in past studies for the variables examined in the current study. There were no subtype differences for IQ. The expectation that the H/I subtype would have higher IQ than the IA and C subtypes was not fulfilled. However, the H/I subtype did have IQ scores 5 points greater than both the IA and C subtypes, and the H/I subtype did not differ from the control group.

Table 30

Summary of Findings on Variables Compared in Study 2

	Variables	Expected*	Outcome
Child	IQ	H/I = C > IA	IA = H/I = C
	Academic - Reading	IA > C > H/I	C > IA; IA = H/I
	Spelling	IA > C > H/I	IA = H/I = C
	Maths	IA > C > H/I	IA = H/I = C
	SIP – Intent	IA = H/I = C	IA = H/I = C
	Response	IA = H/I = C	IA = H/I = C
	Feeling	IA = H/I = C	IA = H/I = C
	Parenting – Rejection	H/I = C > IA	IA = H/I = C
	Overprotect	H/I = C > IA	IA = H/I = C
	Warmth	IA = H/I = C	IA = H/I = C
Teacher & Mother	IA symptoms	IA = C > H/I	IA = C > H/I
	H/I symptoms	H/I = C > IA	H/I = C > IA
	ODD symptoms	H/I = C > IA	(T) IA = H/I = C (M) H/I = C > IA
	Anxiety	IA = C > H/I	IA = H/I = C
	Aggression – Reactive	H/I = C > IA	(T) C > IA; H/I = C (M) IA = H/I = C
	Proactive	IA = H/I = C	(T) IA = H/I = C (M) H/I = C > IA
	Covert	IA = H/I = C	(T) IA = H/I = C (M) C > IA = H/I
Mother	GHQ – Somatic	H/I = C > IA	IA = H/I = C
	Anxiety	H/I = C > IA	IA = H/I = C
	Soc. Dysfunct'n	H/I = C > IA	IA = H/I = C
	Depression	H/I = C > IA	IA = H/I = C

Note: IA = inattention, H/I = hyperactivity-impulsivity; (T) = teacher ratings, (M) = mother ratings. * All subtype comparisons except for ODD symptoms based on screening for ODD.

Although there have been very few studies comparing the three subtypes, taken overall the data of the H/I subtype having higher IQ than the IA and C subtypes are generally consistent with past studies showing the H/I subtype to have higher IQ (Lahey et al., 1998; Willcutt et al., 1999), higher academic learning and performance (Gaub & Carlson, 1997a, McBurnett et al., 1999), and fewer special education referrals (Nolan et al., 2001).

Related to this area, for academic functioning, it was expected that inattention problems would differentiate between the subtypes, with the inattention subtypes (ie., IA and C subtypes) having higher problem scores than the subtype with only hyperactivity-impulsivity (ie., H/I subtype). Although no subtype differences were found for spelling and maths, for reading, one of the subtypes with inattention problems (ie., C subtype) did differ significantly from the subtype without inattention problems (ie., H/I subtype). Thus for academic functioning, although not confirming the hypotheses, the results were still to some degree in line with expectation, and several past results (Lahey et al., 1998; McBurnett et al., 1999; Nolan et al., 2001), as inattention was implicated with more academic functioning problems than hyperactivity-impulsivity per se.

The results for anxiety were contrary to expectation as no subtype differences emerged, with, or without controlling for ODD. These results should be considered in the context that there have been very few subtype studies for anxiety, and most have only compared the IA and C subtypes. Those few studies including comparisons of the H/I subtype with the IA and C subtypes (Faraone et al., 1998; Gaub & Carlson, 1997a; Nolan et al., 2001) have not screened for ODD, and have generally produced mixed results. Accordingly, it was hoped that screening for the influence of ODD in the current study might further elucidate this issue. Given that there were no subtype differences with, or without controlling for ODD, the findings in the current study extend the past findings and imply that anxiety does not necessarily differentiate between the subtypes.

This study is the first to consider subtype differences for social cognition, and aggression style. Several past studies (Abikoff & Klein, 1992; Dodge et al., 1997; Dodge & Frame, 1982; Halperin et al., 1990) have implicated hyperactivity-impulsivity (ie., the H/I and C subtypes) with the exhibition of more externalising behaviours, including more hostile-biased social cognitions, ODD/CD symptoms, and increased aggression. By contrast, other more recent studies (Coy et al., 2001; Gomez & Gomez, 2003; Waschbusch et al., 1998) have shown that aggression is much more strongly associated with hostile-based social cognitions, ODD/CD, and aggressive behaviours than hyperactivity-impulsivity.

The hypotheses for the social cognition variables were not sustained. While the hypotheses were to some degree predicated on the notion that ADHD children with hyperactivity-impulsivity were more likely to have comorbid ODD, thereby increasing the probability of them having more hostile-biased social cognitions (see Coy et al., 2001; Gomez & Gomez, 2003), the results both with, and without controlling for ODD showed no subtype differences. Thus while these results are contrary to the notion in several past studies that hyperactivity-impulsivity may be implicated with hostile-biased social cognitions as a function of increased aggression, they nevertheless are supportive of the findings in more recent studies (Coy et al., 2001; Gomez et al., 2003) that increased aggression was more related to comorbidity between hyperactivity-impulsivity and ODD, rather than hyperactivity-impulsivity.

By contrast, prior to screening for ODD, the results for aggression style indicated that the C subtype, (and to a much lesser extent the H/I subtype) had more aggression style problems than the IA subtype. While, superficially, these results appear to indicate that hyperactivity-impulsivity is more associated with aggression style, at a deeper level they show a completely different picture. After screening for ODD hyperactivity-impulsivity per se is no longer associated with aggression style, rather it is the combination of inattention and hyperactivity-impulsivity (ie., C subtype) that imbues a greater risk for different aggression style problems. Alternatively, it may be speculated that the C subtype has higher ODD and RAGG because the ODD and RAGG scales are essentially measuring the same construct. Thus the degree of item overlap between these scales would explain why there are so comparatively few differences between teacher and mother ratings of the RAGG measure for the different subtypes after controlling for ODD.

Finally, two other variables were examined, namely maternal parenting style, and maternal mental health. Given that to date there have been very few subtype studies examining these variables, and the results in these studies have been mixed (Gadow et al., 2000; Graetz et al., 2001), it was hoped that the findings in the current study would further clarify the current findings. However, neither the child-rated parenting style variables nor the maternal self-ratings of mental health found any association between subtypes. That, with, and without screening for ODD, no subtype differences were evident tends to imply that the maternal variables are not necessarily unduly influenced by ADHD subtypes.

7 . 8 . 2 Implications for the validity of the ADHD subtypes

The current study found few differences among the subtypes except for the reading subtest of academic functioning and the different aggression style measures.

The reading subtest differentiated subtypes with the C subtype having lower scores than the IA subtype, and the C subtype also had lower scores than the H/I subtype with the result approaching significance ($p = .06$). However the remaining academic functioning measures, spelling and maths, showed no subtype distinctions, Thus a lack of consistent subtype distinctions across different facets of academic functioning may point to difficulties in distinguishing between subtypes on the basis of academic-related variables.

Aggression style also differentiated between subtypes. Each of the aggression style measures showed different responses between teachers and mothers. For instance, for proactive aggression, only mother ratings showed differences, with the H/I and C subtypes having higher proactive aggression than the IA subtype. For covert aggression, only mother ratings showed differences, with the C subtype having higher scores than the IA and H/I subtypes. For reactive aggression, mother ratings showed no distinctions, whereas teacher ratings showed that the C subtype had higher scores than the IA subtype. Taken together, the results across the different aggression style measures have shown distinctions among the three subtypes, and hence have provided support for their external validity.

However, in view of the lack of distinction between the subtypes for the remaining variables in the current study, the overall results raise some important implications for the validity of the subtypes. The data generally showed greater distinction between the IA and C subtypes than the IA and H/I subtypes. Given that generally the H/I subtype did not differ from the C subtype it could be interpreted that the H/I subtype is similar to the C subtype. Indeed the lack of distinction between the H/I and C subtypes in the current study is consistent with the findings in past studies (Applegate et al., 1997; Barkley, 1997; Lahey et al., 1998) suggesting that the H/I subtype may be developmentally precursive of the C subtype. Therefore the overall data implies little support for the validity of the H/I subtype. Nevertheless, given that this study only used a limited number of measures, the findings need to be treated with caution. It may be that other studies using a different and greater range of measures will produce results more supportive of the validity of the H/I subtype.

In addition, there may be an alternative explanation for the lack of subtype distinctions. Although parents had indicated that the children had not received medication at least 48 hours prior to testing, it remains likely that perceptions of children's long-term learned behaviours would have been reflected in teacher and parent ratings. Thus, it could be that the failure to find distinctions among subtypes is related to the shared effects of medication and psychosocial interventions. As shown in Table 22, ADHD mothers reported that more than 80% of the ADHD children were receiving medication, and of those receiving medication in excess of 70% of each group were taking psychostimulants. As well nearly 90% of mothers of ADHD children reported that they had received specialised training in the behavioural management of their ADHD children. Thus given these statistics, it seems reasonable to surmise that the effects of such medical or psychosocial interventions should minimise differences among the subtypes.

However despite the appeal of this interpretation to explain the lack of subtype distinctions in the current study, this interpretation fails to explain the consistent distinctions between the subtypes and control group. That is, despite the effects of the purported medical or psychosocial benefits, the ADHD subtypes still differed from the control group across a range of measures. Given this, it is suggested that the proposition that medical or management effects may have accounted for the lack of subtype distinctions must be treated with considerable circumspection.

Taken overall, the findings indicated partial support for the external validity of the three subtypes. The lack of distinction between the H/I and C subtypes, and greater distinction between the IA and C subtypes implied minimal support for the validity of the H/I subtype. In turn this implied a subtype structure based on comparison between the IA and C subtypes. Such a system would suggest two subtypes based on two distinct ADHD disorders; a purely inattention disorder, and a disorder combining the inattention and hyperactivity-impulsivity dimensions. Such an organisation of the ADHD symptom structure is more in alignment with the DSM-III approach, with the IA subtype to some degree proximal to the DSM-III ADDD subtype, and the C subtype to some degree proximal to the DSM-III ADDH subtype.

Nevertheless given that such an interpretation of the current study's findings is contrary to the DSM-IV subtyping, this interpretation requires further substantiation. Replication of the results is necessary before the current data can be confirmed as reliable evidence of the limited external validity of the three subtypes. In addition, there is the need for studies to explore other variables not examined in this thesis to further clarify this issue. As well, to further explore the validity of the H/I subtype, longitudinal designs appear necessary to resolve the question of type stability. It may be that, as suggested by other researchers (Barkley, 1997; Lahey et al., 1998), that the H/I subtype is precursive of the C subtype, and that there are few differences between the H/I and C subtypes in older children. Related to this, future studies might show the H/I subtype to have more relevance for younger children, especially preschool or very young primary school children. Such a proposition would indicate the need for the next diagnostic manual, DSM-V, to include a note alerting diagnosticians to the implications of age differences for the H/I subtype.

7 . 9 Strengths and limitations of Study 2

This study is to the author's knowledge the first study to examine DSM-IV ADHD subtypes across a range of measures with, and without controlling for ODD effects. Although a few past studies differentially screened for ODD, no study has been specifically designed to compare subtypes with, and without the effects of ODD. It is also the first study of ADHD subtypes to consider the areas of child social cognition, child perception of parenting style, and parent perception of child aggression style.

By contrast, several potential limitations are acknowledged in the interpretation of the results. This study did not systematically assess comorbid psychopathology other than ODD, therefore it may have failed to detect important differences between subtypes attributable to the presence of other disorders such as anxiety, depression, or learning disorders.

The results in this study should also be considered in terms of the present debate concerning the validity of a separate H/I subtype (Applegate et al., 1997;

Barkley et al., 1997; Lahey et al., 1998, McBurnett et al., 1999). As can be seen by the data in Table 20, the H/I subtype has been examined in only relatively few studies. By contrast more studies have focused on comparisons between the IA and C subtypes. Also, due to the limited numbers of the H/I subtype so far found in studies with the three subtypes, it has been suggested that any results provided by the H/I sample should be interpreted with caution due to both the limited sample size, and the lack of differences between the subtypes, and the consequent reduced power of comparisons involved for the measures being examined.

The study also did not control for the potential influence of subject bias in responses given for the child self-perceived social cognition and parenting style measures. While subtype differences were predicted for these variables the results were contrary to expectation. Social bias and social desirability effects may be especially pertinent for ADHD children. For instance, many ADHD children, despite possible self-parent conflicts, may still publicly demonstrate loyalty and positive regard to their parents, as a defence mechanism to the "often social ostracism" imposed by the disorder. Indeed, it may be that such inadvertent social effects have influenced the ratings given by children for these different measures.

Another potential limitation to the generalisability of the results in this study is the apparent gender imbalance in the sample, although it must be stated that the gender ratios in this study approximate those suggested by DSM-IV estimates (APA, 1994, p. 82) and many other studies (Anderson et al., 1987; Cohen et al., 1993; Szatmari et al., 1989; Wolraich et al., 1996). Finally the cross-sectional design precludes inference of any causal relationships. Future studies might consider the practicality of longitudinal designs to test subtype differences across a range of measures, while controlling for comorbid psychopathology, especially the influence of ODD/CD, anxiety, and learning problems.

7 . 10 Future directions for research on ADHD

Recent CFA studies have consistently found support for a two-factor model of the structural organisation of the ADHD symptoms consisting of IA and H/I. While this data has supported the DSM-IV organisation of the ADHD symptoms, the data has also shown high correlations between the IA and H/I factors.

Burns et al. (in press), and Gomez et al. (2003), have stated that the high correlation could be due to the use of single source ratings in different settings (ie., teacher ratings only at school, and parent ratings only at home). In the past single source ratings with ADHD rating scales have been used to examine relations between the IA and H/I constructs, their associated features, and the impacts of treatment. Recent studies by Gomez et al. (2003) have shown that statistical data derived from the observed scores associated with simple correlations or analysis of variance is not able to separate trait and source effects, hence the correlations between variables may be overinflated. By contrast latent variable models based on CFA MTMS designs allow for the simultaneous analysis of convergent and discriminant validity as well as the separation of trait from source effects and hence are likely to present a truer picture of relations between constructs (Lance et al., 2002).

It is therefore suggested that the use of a CFA MTMS approach could more accurately reflect the relations of the IA and H/I constructs with other measures including those examined in Study 2. Clearly, the type of research conducted by

Gomez and colleagues is important because it represents an alternative and more accurate way to interpret relations among constructs. Indeed, CFA MTMS designs appear necessary to advance understanding of ADHD, because in separating trait and source effects they allow for the differential ability of trait and source effects to predict risk factors, associated features and outcomes.

In addition, given the high source effects found for the ratings of ADHD symptoms in Study 1, it can be argued that source effects could potentially contribute to other diagnostic procedures and techniques, including clinical interviews. Thus it is possible that source effects confounded the establishment of the diagnostic groups in Study 2. This raises the possibility that the clinical groups in Study 2 may not have been as clearly distinguished as intended, thereby reducing or eliminating differences between them. The research implication of this is that for a clear understanding of the differences between the ADHD groups there is a need to ensure that source effects are minimised in the diagnostic procedure (such as using multisource by multimethod designs), or that a method be developed to partial out the source effects in the analysis. At present these issues have not been extensively researched. It will be useful if future studies can examine these issues.

Finally, construct validity can also be investigated using latent class analysis. As distinct from factor analytic approaches that assume an underlying dimensional structure, latent class analysis has the potential of distinguishing between dimensional and categorical models (Rohde et al., 2001). It is suggested that latent class models may provide an alternative means to clarify relations between the IA, HYP, and IMP dimensions, and in particular research on latent class subtypes is necessary to extend understanding of the biological and psychological risk factors for different types of ADHD children. Rasmussen and colleagues (Rasmussen, Neuman et al., 2002; Rasmussen, Todd et al., 2002) have intimated that such a process might lead to the development of treatment options tailored to the specificity and severity of symptoms, rather than the general clinical practice of treatment based mainly on categorical subtype distinctions.

7 . 11 Concluding summary

Many studies during the past two decades have examined the validity of ADHD, one of the most common childhood psychopathologies. However changes in the conceptualisation and diagnostic criteria of ADHD within the classification systems in the different DSM editions has warranted the need to continuously establish the validity of this disorder.

To date no study has used a CFA MTMS approach to examine the construct validity of the ADHD symptoms in children with a primary ADHD diagnosis. In addition, most studies that have examined the external validity of the ADHD disorders have not included all three subtypes. Given this, this thesis was aimed at examining the construct validity of the ADHD disorder using CFA MTMS in a group of children with the ADHD diagnosis, and also the differences among the three ADHD subtypes.

It has been proposed that as the first part of construct validity, the internal validity of a disorder such as ADHD can be examined by testing the structural organisation of the ADHD symptoms. In this thesis, the results in Study 1 showed some support for the way the ADHD symptoms are organised in DSM-IV. That is, at the matrix level there was support for the convergent and discriminant validity of the ADHD symptoms, but at the symptom parcels level the strong source effect tempered the findings at the matrix level.

External validity, the second part of the construct validity process, can be examined by testing the correlates of the ADHD subtypes with other constructs (ie., ODD, anxiety, aggression, peer relations). In this thesis, the results in Study 2 showed partial support for the external validity of the DSM-IV subtypes. That is, across the different aggression style measures the data demonstrated distinctions among the three ADHD subtypes. Taken together, the results for the two studies provide some support for the construct validity of ADHD.

However while the results showed some support for the construct validity of ADHD, the findings must be viewed within a broader framework of the limitations of the present study in terms of methods to examine the construct validity of the disorder.

This thesis only examined one of two means for establishing the internal validity of ADHD. The second way of establishing internal validity would involve testing the substantive validity of the disorder by examining the extent to which the ADHD symptoms accurately reflect the construct that they are purported to represent (Loevinger, 1957). In addition, this thesis only examined differences among subtypes to establish the external validity of ADHD. There are many other equally useful ways to test the external validity of the ADHD subtypes. These include examining prevalence rates, gender differences, biological factors, genetic factors especially family aggregation, and comorbidity with other disorders such as ODD, anxiety and learning disorders (Cantwell, 1996). In addition, and more importantly, there is the need to conduct studies to test how the ADHD disorders are distinguishable from other childhood clinical disorders.

In conclusion, to the author's knowledge this is the first study to examine the construct validity of ADHD with a group of ADHD children. Of particular note is its use of CFA MTMS procedures to establish the internal validity of the ADHD symptoms. Gomez et al. (2003) have proposed that CFA MTMS designs might serve as a model for future validity studies of childhood disorders in general. The adoption of such procedures and processes should help to further explicate understanding of the nature, assessment and treatment of these disorders, as shown in this study.

References

Abikoff, H. (1985). Efficacy of cognitive training interventions in hyperactive children: A critical review. *Clinical Psychology Review, 5*, 479-512.

Abikoff, H. (1987). An evaluation of cognitive behavior therapy for hyperactive children. In B. B. Lahey & A. E. Kazdin (Eds.), *Advances in clinical child psychology*. New York: Plenum.

Abikoff, H. (1991). Cognitive training in ADHD children: Less to it than meets the eye. *Journal of Learning Disabilities, 24*, 205-209.

Abikoff, H., & Gittelman, R. (1984). Does behavior therapy normalise the classroom behavior of hyperactive children? *Archives of General Psychiatry, 41*, 449-454.

Abikoff, H., & Klein, R. G. (1992). Attention deficit hyperactivity and conduct disorder: Comorbidity and implications for treatment. Special section: Comorbidity and treatment implications. *Journal of Consulting and Clinical Psychology, 60*, 881-892.

Achenbach, T. M. (1991). *Manual for the child behavior checklist/4 -18 and 1991 profile*. Burlington, VT: Department of Psychiatry.

Achenbach, T. M., & Edelbrock, C. S. (1983). *Manual for the child behavior checklist and revised child behavior profile*. Burlington, VT: Department of Psychiatry.

Achenbach, T. M., & Edelbrock, C. S. (1987). *Manual for the child behavior checklist and youth self-report form*. Burlington, VT: Department of Psychiatry.

Achenbach, T. M., McConaughy, S. H., & Howell, C. T. (1987). Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin, 101*, 213-232

Ackerman, P. T., Dykman, R. A., Holcomb, P. J., & McCray, D. S. (1982). Methylphenidate effects on cognitive style and reaction time in four groups of children. *Psychiatry Research, 7*, 199-213.

Ackerman, P. T., Dykman, R. A., & Oglesby, D. M. (1983). Sex and group differences in reading and attention disordered children with and without hyperkinesis. *Journal of Learning Disabilities, 16*, 407-415.

Ahmann, P. A., Waltonen, S., Olson, K. A., Theye, F. W., Van Erem, A. J., & LaPlant, R. J. (1993). Placebo-controlled evaluation of ritalin side effects. *Pediatrics, 91*, 1101-1106.

Aman, C. J., Roberts, R. J., & Pennington, B. F. (1998). A neuropsychological examination of the underlying deficit in attention deficit hyperactivity disorder: frontal lobe versus right parietal lobe theories. *Developmental Psychology, 34*, 956-969.

American Psychiatric Association. (1968). *Diagnostic and statistical manual of mental disorders* (2nd ed.). Washington, DC: Author.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Washington, DC: Author.

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd. revised ed.). Washington, DC: Author.

American Psychiatric Association. (1991). *DSM-IV options book: Work in progress*. Washington, DC: Author.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Amin, K., Douglas, V., Mendelson, M. J., & Dufresene, J. (1993). Separable/integral classification by hyperactive and normal children. *Development and Psychopathology, 5*, 415-431.

Anderson, J. C., Williams, S., McGee, R., & Silva, P. A. (1987). The prevalence of DSM-III disorders in a large sample of pre-adolescent children from the general population. *Archives of General Psychiatry, 44*, 69-81.

Anderson, J. C., Williams, S., McGee, R., & Silva, P. A. (1989). Cognitive and social correlates of DSM-III disorders in pre-adolescent children. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 842-846.

Applegate, B., Lahey, B. B., Hart, E. L., Biederman, J., Hynd, G. W., Barkley, R. A., et al. (1997). Validity of the age-of-onset criterion for ADHD: A report from the DSM-IV field trials. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1211-1221.

Arnold, L. E., Abikoff, H. B., Cantwell, D. P., Conners, C. K., Elliott, G., Greenhill, L. L., et al.1997). National Institute of Mental Health collaborative multimodal treatment study of children with ADHD (the MTA). *Archives of General Psychiatry, 54*, 865-870.

Arrindell, W. A., Gerlsma, C., Vandereycken, W., Hageman, W. J., & Daeseleire, T. (1998). Convergent validity of the dimensions underlying the parental bonding instrument (PBI) and the EMBU. *Personality and Individual Differences, 24*, 341-350.

Arrindell, W. A., Hanewald, G. F., & Kolk, A. M. (1989). Cross-national constancy of dimensions of parental rearing style: The Dutch version of the parental bonding instrument. *Personality and Individual Differences, 10*, 949-956

Atkins, M. S., Pelham, W. E., & Licht, M. H. (1985). A comparison of objective classroom measures and teacher ratings of attention deficit disorder. *Journal of Abnormal Child Psychology, 13*, 155-167.

Atkins, M. S., Pelham, W. E., & White, K. J. (1989). Hyperactivity and attention deficit disorders. In M. Hersen (Ed.), *Psychosocial aspects of developmental and physical disabilities: A casebook.* Newbury Park, CA: Sage.

Atkins, M. S., & Stoff, D. M. (1993). Instrumental and hostile aggression in ADHD behavioral disorders. *Journal of Abnormal Child Psychology, 21*, 165-178.

August, G. J., & Garfinkel, B. D. (1993). The nosology of attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 155-165.

Australian Bureau of Statistics. (1996). *ASCO - Australian standard classification of occupations*. Canberra: Author.

Avila, C. (2001). Distinguishing BIS mediated and BAS mediated disinhibition mechanisms: A comparison of disinhibition models of Gray (1981, 1987) and of Patterson and Newman (1993). *Journal of Personality and Social Psychology, 80*, 311-324.

Aylward, E. H., Reiss, A. L., Reader, M. J., & Singer, H. S. (1996). Basal ganglia volumes in children with attention-deficit hyperactive disorder. *Journal of Child Neurology, 11*(2), 112-115.

Bandura, A. (1973). *Aggression: A social learning analysis.* Englewood Cliffs, NJ: Prentice Hall.

Barkley, R. A. (1989). Hyperactive girls and boys: Stimulant drug effects on mother-child interactions. *Journal of Child Psychology and Psychiatry, 30,* 379-390.

Barkley, R. A. (1990). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment.* New York: Guilford.

Barkley, R. A. (1994). Impaired delayed responding: A unified theory of attention deficit hyperactivity disorder. In D. K. Routh. (Ed.), *Disruptive behaviour disorders: Essays in honor of Herbert Quay* (pp. 11-57). New York: Plenum.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*(1), 65-94.

Barkley, R. A. (1998a). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment.* New York: Guilford.

Barkley, R. A. (1998b). *Attention deficit hyperactivity disorder: A clinical workbook.* New York: Guilford.

Barkley, R. A. (1998c). Attention-deficit/hyperactivity disorder. In E. J. Mash & R. A. Barkley (Eds.), *Treatment of childhood disorders,* (pp. 55-110). NewYork: Guilford.

Barkley, R. A. (1999). Theories of ADHD. In H. C. Quay & A. E. Hogan (Eds.), *Handbook of disruptive behavior disorders* (pp. 295-316). New York: Kluwer Academic/Plenum Press.

Barkley, R. A., & Biederman, J. (1997). Toward a broader definition of the age-of- onset criterion for attention-deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1204-1210.

Barkley, R. A., DuPaul, G. L., & McMurray, M. B. (1990). Comprehensive evaluation of attention deficit disorder with and without hyperactivity as defined by research criteria. *Journal of Consulting and Clinical Psychology, 58*, 775-789.

Barkley, R. A., Fischer, M., Edelbrock, C., & Smallish, L. (1991). The adolescent outcome of hyperactive children diagnosed by research criteria-III. Mother-child interactions, family conflicts and maternal psychopathology. *Journal of Child Psychology and Psychiatry, 32*, 233-255.

Barkley, R. A., Grodzinsky, G. M., & DuPaul, G. J. (1992). Frontal lobe functions and attention deficit disorder with and without hyperactivity. *Journal of Abnormal Child Psychology, 20*, 163-188.

Barkley, R. A., McMurray, M. B., Edelbrock, C., & Robbins, K. (1990). Side effects of methylphenidate in children with attention deficit hyperactivity disorder: A systemic placebo-controlled evaluation. *Pediatrics, 86*, 184-192.

Barrickman, L., Noyes, R., Kuperman, S., Schumacher, S., & Verda, M. (1991). Treatment of ADHD with fluoxetine: A preliminary trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 762-767.

Bauermeister, J. J. (1992). Factor analysis of teacher ratings of attention deficit hyperactivity disorder and oppositional defiant symptoms in children aged four through thirteen years. *Journal of Clinical Psychology, 21*, 27-34.

Bauermeister, J. J., Bird, H. R., Canino, G., Rubio-Stipec, M., Bravo, M., & Alegria, M. (1995). Dimensions of attention deficit hyperactivity disorder:

Findings from teacher and parent reports in a community sample. *Journal of Clinical Child Psychology, 24*, 264-271.

Baumgaertel, A., Wolraich, M. L., & Dietrich, M. (1995). Comparison of diagnostic criteria for attention deficit disorders in a German elementary school sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 629-638.

Baumrind, D. (1973). The development of instrumental competence through socialisation. In A. Pick (Ed.), *Minnesota symposium on child psychology: Vol. 7.* (pp. 3-46.). Minneapolis: University of Minnesota Press.

Benedetto, J., & Tannock, R. (1999). Math computation, error patterns and stimulant effects in children with attention-deficit hyperactivity disorder. *Journal of Attention Disorders, 3*,121-134.

Bentler, P. M. (1995). *EQS: Structural equations programs manual.* Encino, CA: Multivariate Software.

Berkowitz, L. (1963). *Aggression: A social psychological analysis.* New York: McGraw-Hill. Berry, C. A., Shaywitz, S. E., & Shaywitz, B. A. (1985). Girls with attention deficit disorder: A silent minority? A report on behavioral and cognitive characteristics. *Pediatrics, 76*, 801-809.

Biederman, J., Faraone, S. V., Keenan, K., Benjamin, J., Krifcher, B., Moore, C., et al. (1992). Further evidence for family-genetic risk factors in attention deficit hyperactivity disorder. Patterns of comorbidity in probands and relatives in psychiatrically and pediatrically referred samples. *Archives of General Psychiatry, 49*, 728-738.

Biederman, J., Faraone, S. V., Keenan, K., Knee, D., & Tsuang, M. T. (1990). Family-genetic and psychosocial risk factors in DSM-III attention deficit disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 526-533.

Biederman, J., Faraone, S. V., Keenan, K., Steingard, R., & Tsuang, M. T. (1991). Familial association between attention deficit disorder and anxiety disorders. *American Journal of Psychiatry, 148*, 251-256.

Biederman, J., Milberger, S., Faraone, S. V., Kiely, K., Guite, J., Mick, E., et al. (1995a). Family-environment risk factors for attention deficit hyperactivity disorder: A test of Rutter's indicators of adversity. *Archives of General Psychiatry, 152*, 464-470.

Biederman, J., Milberger, S., Faraone, S. V., Kiely, K., Guite, J., Mick, E., et al. (1995b). Impact of adversity on functioning and comorbidity in children with attention deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 1495-1503.

Biederman, J., Wozniak, J. R., Kiely, K., Ablon, S., Faraone, S. V., Mick, E., et al. (1995). CBCL clinical scales discriminate pre-pubertal children with structured interview-derived diagnosis of mania from those with ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 464-471.

Birch, H. G. (1964). *Brain damage in children: The biological and social aspects*. Baltimore: Williams and Wilkins.

Bird, H. R., Gould, M. S., & Staghezza, B. M. (1993). Patterns of diagnostic comorbidity in a community sample of children aged 9 through 16 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 361-368.

Bloomquist, M. L., August, G. J., Cohen, D. J., Doyle, A., & Everhart, K. (1997). Social problem solving in hyperactive-aggressive children: How and what they think in conditions of automatic and controlled processing? *Journal of Clinical Child Psychology, 26*, 172-180.

Borden, K. A., & Brown, E. T. (1989). Attributional outcomes: The subtle message of treatments for attention deficit disorder. *Cognitive Therapy and Research, 13*, 147-160.

Boris, M., & Mandel, F. S. (1994). Foods and additives are common causes of the attention deficit hyperactivity disorder in children. *Annals of Allergy, 72*, 462-467.

Bradley, J. D., & Golden, C. J. (2001). Biological contributions to the presentation and understanding of atttention-deficit/hyperactivity disorder: A review. *Clinical Psychology Review, 21*, 907-929.

Braswell, L., & Bloomquist, M. L. (1991). *Cognitive-behavioral therapy with ADHD children: Child, family and school interventions*. New York: Guilford.

Brito, G. N., Pinto, R. C., & Lins, M. F. (1995). A behavioral assessment scale for attention deficit disorder in Brazilian children based on DSM-III-R criteria. *Journal of Abnormal Child Psychology, 23*, 509-520.

Bronowski, J. (1977). Human and animal languages. In J. Bronowski (Ed.), *A sense of the future*. Cambridge, MA: MIT Press.

Brown, R. T., Borden, K. A., Wynne, M. E., Spunt, A. L., & Clingerman, S. R. (1987). Compliance with pharmacological and cognitive treatment for attention deficit disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 521-526.

Brown, K., Atkins, M. S., Osbourne, M. L., & Milnamow, M. (1996). A revised teacher rating scale for reactive and proactive aggression. *Journal of Abnormal Child Psychology, 24*, 473-479.

Browne, M. W., & Cudeck, (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models.* Newbury Park, CA: Sage.

Buckley, M. R., Cote, J. A., & Comstock, S. M. (1990). Measurement errors in the behavioral sciences: The case of personality/attitude research. *Educational and Psychological Measurement, 50*, 447-474.

Burns, B. (1991). Mental health service use by adolescents in the 1970's and 1980's. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 144-150.

Burns, G. L., Boe, B., Walsh, J. A., Sommers-Flanagan, R., & Teegarden, L. A. (2001). A confirmatory factor analysis on the DSM-IV ADHD and ODD symptoms: What is the best model for the organisation of the symptoms? *Journal of Abnormal Child Psychology, 29*, 339-349.

Burns, G. L., Gomez, R., Walsh, J. A., & de Moura, M. A. (2003). Understanding source effects in ADHD Rating Scales: Reply to DuPaul (2003). *Psychological Assessment, 15*, 1-2.

Burns, G. L., Walsh, J. A., & Gomez, R. (in press). Stability of trait and source variance in the ADHD-inattention and ADHD-hyperactivity/impulsivity symptom dimensions: The importance of multitrait-multisource analyses for understanding ADHD.

Burns, G. L., Walsh, J. A., Owens, S. M., & Snell, J. (1997). Internal validity of attention-deficit hyperactivity disorder, oppositional disorder, and overt conduct disorder symptoms in young children: Implications from teacher ratings for a dimensional approach to symptom validity. *Journal of Clinical Child Psychology, 26*, 266-275.

Burns, G. L., Walsh, J. A., Patterson, D. R., Holte, C. S., Sommers-Flanagan, R., & Parker, C. M. (1997). Internal validity of the disruptive behavior disorder symptoms: Implications from parent ratings for a dimensional approach to symptom validity. *Journal of Abnormal Child Psychology, 25*, 307-319.

Byrne, B. M. (1998). *Structural equation modelling with LISREL, PRELIS, and SIMPLIS: basic concepts, applications, and programming*. Mahwah, NJ: Erlbaum

Byrne, B. M., & Bazana, P. G. (1996). Investigating the measurement of social and academic competencies for early/late preadolescents and adolescents: A multitrait- multimethod analysis. *Applied Measurement in Education, 9*, 113-132.

Campbell, D., & Ewing, L. J. (1990). Follow up of hard to manage preschoolers: Adjustment at age 9 and predictors of continuing symptoms. *Journal of Child Psychology and Psychiatry, 31*, 871-889.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56*, 81-105.

Campbell, J. M. (1998). Internal and external validity of seven Weschler intelligence scale for children-third edition short forms in a sample of psychiatric inpatients. *Psychological Assessment, 10*, 431-434.

Campbell, S. B. (1990). *Behavior problems in preschool children: Clinical and developmental issues*. New York: Guilford.

Campbell, S. B. (1997). Behavior problems in preschool children: Developmental and family issues. In T. H. Ollendick & R. J. Prinz (Eds.), *Advances in clinical child psychology* (Vol. 19). New York: Plenum.

Campbell, S. B. (2000). Attention-deficit/hyperactivity disorder. In A. J. Sameroff, M. Lewis, & S. M. Miller (Eds.), *Handbook of developmental psychopathology* (2nd ed.). New York: Kluwer Academic/Plenum.

Campbell, S. B., & Werry, J. B. (1986). *Attention deficit disorder* (3rd ed.). New York: Wiley. Cantwell, D. P. (1972). Psychiatric illness in the families of hyperactive children. *Archives of General Psychiatry, 27*, 411-417.

Cantwell, D. P. (1975). Familial-genetic research with hyperactive children. In D. P. Cantwell (Ed.), *The hyperactive child: Diagnosis, management, and current research* (pp. 93-105). NewYork: Spectrum.

Cantwell, D. P. (1980). A clinician's guide to the use of stimulant medication for psychiatric disorders of children. *Journal of Developmental and Behavior Pediatrics, 1*, 133-140.

Cantwell, D. P. (1996). ADHD: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 978-987.

Cantwell, D. P., & Baker, L. (1984). The attention deficit syndrome current knowledge, future needs. *Journal of the American Academy of Child Psychiatry, 23*, 315-318.

Cantwell, D. P., & Baker, L. (1988). Issues in classification of child and adolescent psychopathology. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 521-533.

Cantwell, D. P., & Baker, L. (1989). Stability and natural history of DSM-III childhood diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 691-700.

Cantwell, D. P., & Baker, L. (1992). Attention deficit disorder with and without hyperactivity: A review and comparison of matched groups. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 432-438.

Cantwell, D. P., & Satterfield, J. H. (1978). The prevalence of academic underachievement in hyperactive children. *Journal of Pediatric Psychology, 3*, 168-171.

Carlson, C. (1986). Attention deficit disorder without hyperactivity: A review of preliminary experimental evidence. In B. B. Lahey & A. Kazdin (Eds.). *Advances in clinical child psychology* (Vol 9, pp. 153-176). New York: Plenum.

Carlson, C. L., & Bunner, M. R. (1993). Effects of methylphenidate on the academic performance of children with attention deficit hyperactivity disorder. *School Psychology Review, 22*, 184-198.

Carlson, C. L., Jacobvitz, D., & Sroufe, L. A. (1995). A developmental investigation of inattentiveness and hyperactivity. *Child Development, 66*, 37-54.

Carlson, C. L., Lahey, B. B., Frame, C. L., Walker, J., & Hynd, G. W. (1987). Sociometric status of clinic-referred children with attention deficit disorders with and without hyperactivity. *Journal of Abnormal Child Psychology, 15*, 537-547.

Carlson, C. L., Lahey, B. B., & Neeper, R. (1986). Direct assessment of the cognitive correlates of attention deficit disorders with and without hyperactivity. *Journal of Psychopathology and Behavioral Assessment, 8*, 69-86.

Carlson, C. L., Pelham, W. E., Milich, R., & Dixon, J. (1992). Single and combined effects of methylphenidate and behavior therapy on the classroom performance of children with ADHD. *Journal of Abnormal Child Psychology, 20*, 213-232.

Casey, J. E., Rourke, B. P., & DelDotto, J. E. (1996). Learning disabilities in children with attention deficit disorder with and without hyperactivity. *Child Neuropsychology, 2*, 83-98.

Castellanos, F. X., Giedd, J. N., Eckberg, P., & Marsh, W. L., Vaitusis, W. L., Kaysen, D., et al. (1994). Quantitative morphology of the caudate nucleus in attention deficit hyperactivity disorder. *American Journal of Psychiatry, 151*, 1791-1796.

Castellanos, F. X., Giedd, J. N., Marsh, W. L., Hamburger, S. D., Vaitusis, A. C., Dickstein, D. P., et al. (1996). Quantitative brain magnetic resonance imaging in attention-deficit hyperactivity disorder. *Archives of General Psychiatry, 53*, 607-616.

Castellanos, F. X., & Tannock, R. (2002). Neuroscience of attention-deficit hyperactivitydisorder: the search for endophenotypes. *Nature Reviews: Neuroscience, 3, 617-628.*

Castro, J., Toro, J., van der Ende, J., & Arrindell, W. A. (1993). Explaining the feasibility of assessing parental rearing styles in Spanish children with the EMBU. *International Journal of Social Psychiatry, 39*, 47-57.

Chhabildas, N., Pennington, B. F., & Willcutt, E. G. (2001). A comparison of the neuropsychological profiles of the DSM-IV subtypes of ADHD. *Journal of Abnormal Child Psychology, 29*, 529-540.

Chee, P., Logan, G. D., Schachar, R. J., Lindsay, P., & Wachsmuth, R. (1989). Effects of event rate and display time on sustained attention in hyperactive, normal, and control children. *Journal of Abnormal Child Psychology, 17*, 371-391.

Chess, S. (1960). Diagnosis and treatment of the hyperactive child. *New York Journal of Medicine, 60*, 2379-2385.

Childers, A. T. (1935). Hyper-activity in children having behavior disorders. *American Journal of Orthopsychiatry, 5*, 227-243.

Clark, L. P. (1926). Psychology of essential epilepsy. *Journal of Nervous and Mental Disease, 63*, 575-585.

Clarke, A. R., Barry, R. J., McCarthy, R., & Selikowitz, M. (1998). EEG analysis in attention deficit/hyperactivity disorder: A comparative study of two subtypes. *Psychiatry Research, 81*,19-29.

Clarke, A. R., Barry, R. J., McCarthy, R., & Selikowitz, M. (2001a). Age and sex effects in the EEG: Differences in two subtypes of attention-deficit/hyperactivity disorder. *Clinical Neurophysiology, 112*, 815-826.

Clarke, A. R., Barry, R. J., McCarthy, R., & Selikowitz, M. (2001b). Electroencephalogram differences in two subtypes of attention deficit/hyperactivity disorder. *Psychophysiology, 38*, 212-221.

Clements, S. D. (1966). *Minimal brain dysfunction in children (NINCDS monograph No.3, Public health service publication, No. 1415)*. Washington, DC: United States Government Printing Office.

Cohen, P., Cohen, J., Kasen, S., & Veles, C. (1993). An epidemiological study of disorders in late childhood and adolescence: I. Age-and gender-specific prevalence. *Journal of Clinical Child Psychology and Psychiatry and Allied Disciplines, 34*, 851-867.

Collett, B. R., Crowley, S. L., Gimpel, G., & Greenson, J. N. (2000). The factor structure of DSM-IV attention deficit-hyperactivity symptoms: A confirmatory factor analysis of the ADHD-SRS. *Journal of Psychoeducational Assessment, 18*, 361-373.

Comings, D. E. (1997). Genetic aspects of childhood behavioral disorders. *Child Psychiatry and Human Development, 27*, 139-150.

Conners, C. K., Sitarenios, G., Parker, J. D., & Epstein, J. N. (1998a). The revised Conners Parent Rating Scale (CPRS-R): Factor structure, reliability, and criterion validity. *Journal of Abnormal Child Psychology, 26*, 257-268.

Conners, C. K., Sitarenios, G., Parker, J. D., & Epstein, J. N. (1998b). The revised Conners Teacher Rating Scale (CTRS-R): Factor structure, reliability, and criterion validity. *Journal of Abnormal Child Psychology, 26*, 279-291

Costello, A. J., Edelbrock, C. S., Kalas, R., & Dulcan, M. (1984). *The NIMH diagnostic interview schedule for children*. Worcester, MA: University of Massachusetts Medical School.

Coy, K., Spelz, M. L., DeKlyen, M., & Jones, K. (2001). Social-cognitive processes in preschool boys with and without oppositional defiant disorder. *Journal of Abnormal Child Psychology, 29*, 107-119.

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*, 74-101.

Crick, N. R., & Dodge, K. A. (1996). Social information-processing mechanisms in reactive and proactive aggression. *Child Development, 67*, 993-1002.

Crystal, D. S., Ostrander, R., Chen, R. S., & August, G. (2001). Multimethod assessment of psychopathology among DSM-IV subtypes of children with attention-deficit/hyperactivity disorder: Self, parent, and teacher reports. *Journal of Abnormal Child Psychology, 29*, 189-205.

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*, 16-29.

Dane, A. V., Schachar, R. J., & Tannock, R. (2000). Does actigraphy differentiate ADHD subtypes in a clinical research setting? *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 752-760.

Daugherty, T. K., & Quay, H. C. (1991). Response perseveration and delayed responding in childhood behavior disorders. *Journal of Child Psychology and Psychiatry, 32*, 453-461.

Daugherty, T. K., & Quay, H. C. (1993). Response perseveration, inhibitory control, and central dopaminergic activity in childhood behavior disorders. *Journal of Genetic Psychology, 154*, 177-198.

David, O. J. (1974). Association between lower level lead concentration and hyperactivity. *Environmental Health Perspective, 7*, 17-25.

Decker, S. L., McIntosh, D. E., Kelly, A. M., Nicholls, S. E., & Dean, R. S. (2001). Comorbidity among individuals classified with attention disorders. *International Journal of Neuroscience, 110*, 43-54.

Ding, L., Velicer, W. F., & Harlow, L. L. (1995). Effects of estimation methods, numbers of indicators per factor, and improper solutions on structural equation modeling fit indices. *Structural Equation Modeling, 2*, 119-144.

Dishion, T. J., Burraston, B., & Li, F. (in press). A multimethod and multitrait analysis of family management practices: Convergent and predictive validity. In B. Bukoski, & Z. Amstel (Eds.), *Handbook for drug abuse prevention theory, science, and practice*. New York: Plenum.

Dishion, T. J., & Patterson, G. R. (1999). Model building in developmental psychopathology: A pragmatic approach to understanding and intervention. *Journal of Clinical Child Psychology, 28*, 502-512.

Dodge, K. A. (1980). Social cognition and children's aggressive behavior. *Child Development, 51*, 162-170.

Dodge, K. A. (1986). A social information processing model of social competence in children. In M. Perlmutter (Ed.), *Minnesota symposium on child psychology: Vol. 18*. (pp. 201-218). Hillsdale, NJ: Erlbaum.

Dodge, K. A. (1990). The structure and function of reactive and proactive aggression. In D. Pepler & K. H. Rubin (Eds.), *The development and treatment of childhood aggression* (pp. 201-218). Hillsdale, NJ: Erlbaum.

Dodge, K. A., & Coie, J. D. (1987). Social information processing-factors in reactive and proactive aggression in children's peer groups. *Journal of Personality and Social Psychology, 53*, 389-409.

Dodge, K. A., & Frame, C. L. (1982). Social-cognitive biases and deficits in aggressive boys. *Child Development, 53*, 620-635.

Dodge, K. A., Lochman, J. E., Harnish, J. D., Bates, J. E., & Pettit, G. S. (1997). Reactive and proactive aggression in school children and psychiatrically impaired chronically assaultive youth. *Journal of Abnormal Psychology, 106*, 37-51.

Dodge, K. A., & Newman, J. P. (1981). Biased decision-making processes in aggressive boys. *Journal of Abnormal Child Psychology, 90*, 375-379.

Dodge, K.A., Pettit, G. S., Bates, J. E., & Valente, E. (1995). Social information processing patterns partially mediate the effect of early physical abuse on later conduct problems. *Journal of Abnormal Child Psychology, 104*, 632-643.

Douglas, V. I. (1972). Stop, look and listen: The problem of sustained attention and impulsive control in hyperactive and normal children. *Canadian Journal of Behavioral Science, 4*, 259-282.

Douglas, V. I. (1976). Research on hyperactivity: Stage two. *Journal of Abnormal Child Psychology, 4*, 307-308.

Douglas, V. I. (1980). Higher mental processes in hyperactive children. In D. B. Knight (Ed.), *Treatment of hyperactive and learning disordered children* (pp. 65-91). Baltimore: Park Press.

Douglas, V. I. (1983). Attentional and cognitive problems. In M. Rutter (Ed.), *Developmental neuropsychiatry* (pp. 280-320). New York: Guilford.

Douglas, V. I. (1988). Cognitive deficits in children with attention deficit disorder with hyperactivity. In L. M. Bloomingdale & J. A. Sergeant (Eds.), *Attention deficit disorder: Criteria, cognition, intervention*. London: Pergamon.

Douglas, V. I., Barr, R. G., Amin, K., O'Neill, M. E., & Britton, B. G. (1988). Dosage effects and individual responsivity to methylphenidate in attention deficit disorder. *Journal of Child Psychology and Psychiatry, 29*, 453-475.

Douglas, V. I., & Benezra, E. (1990). Supraspan verbal memory in attention deficit disorder with hyperactivity, normal, and reading disabled boys. *Journal of Abnormal Child Psychology, 18*, 617-638.

Douglas, V. I., & Parry, P. A. (1983). Effects of reward on delayed reaction time task performance of hyperactive children. *Journal of Abnormal Child Psychology, 11*, 313-326.

Douglas, V. I., Parry, P., Marton, P., & Garson, C. (1976). Assessment of a cognitive training program for hyperactive children. *Journal of Abnormal Child Psychology, 4*, 389-410.

Douglas, V. I., & Peters, K. (1979). Toward a clearer definition of the attention deficit of hyperactive children. In G. A. Hale & M. Lewis (Eds.), *Attention and development of cognitive skills* (pp. 173-247). New York: Plenum Press.

Drewe, E. A. (1975). An experimental investigation of Luria's theory on the effects of frontal lobe lesions in man. *Neuropsychologia, 13*, 421-429.

DuPaul, G. J. (1991). Parent and teacher ratings of ADHD symptoms: Psychometric properties in a community-based sample. *Journal of Clinical Child Psychology, 20*, 245-253.

DuPaul, G. J. (2003). Assessment of ADHD symptoms: Comment on Gomez et al. (2003). *Psychological Assessment, 15*, 115-117.

DuPaul, G. J., Anastopoulos, A. D., Power, T. J., Reid, R., Ikeda, M. J., & McGoey, K. E. (1998). Parent ratings of attention-deficit/hyperactivity disorder symptoms: Factor structure and normative data. *Journal of Psychopathology and Behavioral Assessment, 20*, 83-102.

DuPaul, G. J., & Eckert, T. L. (1997). The effects of school-based interventions for attention deficit hyperactivity disorder: A meta-analysis. *School Psychology Review, 26*, 5-23.

DuPaul, G. J., Power, T. J., Anastopoulos, A. D., Reid, R., McGoey, K. E., & Ikeda, M. J. (1997).Teacher ratings of attention deficit hyperactivity disorder symptoms: Factor structure and normative data. *Psychological Assessment, 9*, 436-444.

Dykman, R. A., & Ackerman, P. T. (1991). Attention deficit disorder and specific reading disability: Separate but often overlapping disorders. *Journal of Learning Disabilities, 24*, 96-103.

Edelbrock, C., Costello, A. J., & Kessler, M. D. (1984). Empirical corroboration of attention deficit disorder. *Journal of the American Academy of Child Psychiatry, 23*, 285-290.

Eiraldi, R. E., Power, T. J., & Nezu, C. M. (1997). Patterns of comorbidity associated with subtypes of attention-deficit/hyperactivity disorder among 6-to12-year-old children. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 503-513.

Epkins, C. C., & Meyers, A. W. (1994). Assessment of childhood depression, anxiety, and aggression: Convergent and discriminant validity of self-, parent-, teacher, and peer-report measures. *Journal of Personality Assessment, 62*, 364-381.

Epstein, J., Conners, C. K., Erhardt, D., Arnold, L. E., Hechtman, L., Hinshaw, S. P., et al. (2000). Familial aggregation of ADHD characteristics. *Journal of Abnormal Child Psychology, 28*, 585-594.

Epstein, J. N., Conners, K. C., Ernhardt, D., & March, J. S. (1997). Asymmetric hemisphere control of visual-spatial attention in adults with attention deficit hyperactivity disorder. *Neuropsychology, 11*, 467-473.

Eysenck, H. J. (1967). *The biological basis of personality.* Springfield, IL: Thomas.

Famularo, R., & Fenton, T. (1987). The effect of methylphenidate on school grades in children with attention deficit disorder without hyperactivity: A preliminary report. *Journal of Clinical Psychiatry, 48*, 112-114.

Faraone, S. V., Biederman, J., Keenan, K., & Tsuang, M. T. (1991). Separation of DSM-III attention deficit disorder and conduct disorder: evidence from a family- genetic study of American child psychiatric patients. *Psychological Medicine, 21*, 109-121.

Faraone, S. V., Biederman, J., & Monuteaux, M. C. (2000). Attention-deficit disorder and conduct disorder in girls: Evidence for a familial subtype. *Biological Psychiatry, 48*, 21-29.

Faraone, S. V., Biederman, J., Weber, W., & Russell, R. L. (1998). Psychiatric, neuropsychological, and psychosocial features of DSM-IV subtypes of attention-deficit/hyperactivity disorder: Results from a clinically referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 185-193.

Farrington, D. P., Loeber, R., & Van Kammen, W. B. (1989). Long-term criminal outcomes of hyperactivity-impulsivity-attention deficit and conduct problems in childhood. In L. N. Robins & M. Rutter (Eds.), *Straight and devious pathways to adulthood.* New York: Cambridge University Press.

Feingold, B. F. (1975). Hyperkinesis and learning disabilities linked to artificial food flavors and colors. *American Journal of Nursing, 75*, 797-803.

Fergusson, D. M., Fergusson, J. E., Horwood, L. J., & Kinzett, N. G. (1988). A longitudinal study of dentine levels, intelligence, school performance, and behavior. *Journal of Child Psychology and Psychiatry, 29*, 811-824.

Fergusson, D. M., & Horwood, L. J. (1989). Estimation of method and trait variance in ratings of conduct disorder. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 30*(3), 365-378.

Fillipek, P. A., Semrud-Clikeman, M., Steingard, R. J., Renshaw, P. F., Kennedy, D. N., & Biederman, J. (1997). Volumetric MRI analysis comparing subjects having attention deficit hyperactivity disorder with normal controls. *Neurology, 48*, 589-600.

Fischer, M., Barkley, R. A., Fletcher, J. M., & Smallish, L. (1993). The adolescent outcome of hyperactive children diagnosed by research criteria: II. academic, social, and emotional adjustment. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 324-332.

Fiske, D. W. (1987). Construct validity comes from method effects. *Educational and Psychological Measurement, 47*, 285-336.

Fonseca, A. C., & Yule, W. (1995). Personality and antisocial behavior in children and adolescents: An enquiry into Eysenck's and Gray's theories. *Journal of Abnormal Child Psychology, 23*, 767-781.

Forness, S. R., Swanson, J. M., & Cantwell, D. P. (1992). Response to stimulant medication across six measures of school related performance in children with ADHD and disruptive behavior. *Behavioral Disorders, 18*, 42-53.

Fowles, D. C. (1980). The three-arousal model: Implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology, 25*, 87-104.

Frank, Y., & Ben-Nun, Y. (1988). Toward a clinical subgrouping of hyperactive and non-hyperactive attention deficit disorder: Results of a comprehensive neurological and neuropsychological assessment. *Journal of Diseases in Children, 142*, 153-155.

Frick, P. J., Kamphaus, R. W., Lahey, B. B., Loeber, R., Christ, M. G., Hart, E. L. et al. (1991). Academic underachievement and the disruptive behavior disorders. *Journal of Consulting and Clinical Psychology, 59*, 289-294.

Frick, P. J., Lahey, B. B., Applegate, B., Kerdyck, L., Ollendick, T., Hynd, G. W., et al. (1994). DSM-IV field trials for the disruptive behavior disorders: Symptom utility estimates. *Journal of the American Academy of Child and Adolescent Psychiatry, 33*(4), 529-539.

Fuster, J. M. (1989). *The prefrontal cortex*. New York: Raven Press.

Fuster, J. M. (1995). Memory and planning: Two temporal perspectives of frontal lobe function. In H. H. Jasper, S. Riggio, & P. S. Goldman-Rakic (Eds.), *Epilepsy and the functional anatomy of the frontal lobe*. New York: Raven Press.

Gadow, K. D. (1988). Attention deficit disorder with hyperactivity: Pharmacotherapies. In J. L. Matson (Ed.), *Handbook of treatment approaches in childhood psychopathology*. New York: Plenum.

Gadow, K. D., Nolan, E. E., Litcher, L., Carlson, G. A., Panina, N., Golovakha, E., et al. (2000). Comparison of attention-deficit/hyperactivity disorder symptom subtypes in Ukrainian schoolchildren. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 1520-1527.

Gadow, K. D., Nolan, E. E., Sprafkin, J., & Sverd, J. (1995). School observations of children with attention-deficit hyperactivity disorder and comorbid tic disorder. *Journal of Developmental and Behavioral Pediatrics, 16*, 167-176.

Gammon, G. D., & Brown, T. E. (1993). Fluoxetine and methylphenidate in combination for treatment of attention deficit disorder and combined depressive disorder. *Journal of Child and Adolescent Psychopharmacology, 3*, 1-10.

Garcia-Sanchez, C., Estevez-Gonzales, A., Suarez-Romero, E., & Junque, C. (1997). Right hemisphere dysfunction in subjects with attention deficit disorder with and without hyperactivity. *Journal of Child Neurology, 12*, 107-114.

Gaub, M., & Carlson, C. L. (1997a). Behavioral characteristics of DSM-IV ADHD subtypes in a school-based population. *Journal of Abnormal Child Psychology, 25*(2), 103-111.

Gaub, M., & Carlson, C. L. (1997b). Gender differences in ADHD: A meta-analysis and critical review. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1036-1045.

Gilger, J. W., Pennington, B. F., & DeFries, J. (1992). A twin study of the etiology of comorbidity: Attention-deficit hyperactivity disorder and dyslexia. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 343-348.

Gittelman, R., Mannuzza, S., Shenker, R., & Bonagura, N. (1985). Hyperactive boys almost grown up: I. Psychiatric status. *Archives of General Psychiatry, 42*, 937-947.

Goldberg, D. P. (1972). *The detection of psychiatric illness by questionnaire.* Maudsley Monograph, No. 21. Oxford: Oxford University Press.

Goldberg, D. P. (1991). *A users guide to the general health questionnaire.* London: Oxford University Press.

Goldman-Rakic, P. S. (1995). Architecture of the prefrontal cortex and the central executive. In J. Grafman, K. J. Holyoak, & F. Boller (Eds.), *Structure and functions of the human prefrontal cortex: Volume 769. Annals of the New York Academy of Sciences*. New York: New York Academy of Sciences.

Goldstein, S., & Goldstein, M. (1990). *Understanding and managing attention disorders in children: A guide for practitioners*. New York: Wiley.

Gomez, R., Burns, G. L., Walsh, J. A., & de Moura, M. A. (2003). A multitrait-multisource confirmatory factor analytic approach to the construct validity of ADHD rating scales. *Psychological Assessment, 15*, 3-16.

Gomez, R., & Condon, M. (1999). Central auditory processing ability in children with ADHD with and without learning disabilities. *Journal of Learning Disabilities, 32*, 150-158.

Gomez, R., & Gomez, A. (2000). Perceived maternal control and support as predictors of hostile-biased attribution of intent and response selection in aggressive boys. *Aggressive Behavior, 26*, 155-168.

Gomez, R., & Gomez, A. (2003). The effects of perceived maternal parenting styles on the disruptive behaviors of children with attention deficit hyperactive disorder/oppositional defiant disorder: Mediation by hostile biased social cognitions. In S. P. Shohov (Ed.), *Advances in psychology* (Vol. 11). New York: Nova Science.

Gomez, R., Gomez, A., DeMello, L., & Tallent, R. (2001). Perceived maternal control and support: Effects on hostile biased social information processing and aggression among clinic-referred children with high aggression. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 42*(4), 513-522.

Gomez, R., Harvey, J., Quick, C., Scharer, I., & Harris, G. (1999). DSM-IV ADHD: Confirmatory factor models, prevalence, and gender and age differences based on parent and teacher ratings of Australian primary school children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 40*, 265-274.

Goodman, R., & Stevenson, J. (1989). A twin study of hyperactivity: II. The aetiological role of genes, family relationships and perinatal adversity. *Journal of Child Psychology and Psychiatry, 30*, 691-709.

Gottman, J. M. (1986). Merging social cognition and behavior. *Monographs of the Society for Research in Child Development, 51*(2, Serial No. 213).

Goyette, C. H., Conners, C. K., Petti, T. A., & Curtis, L. E. (1978). Effects of artificial colors on hyperactive children: a double blind challenge study. *Psychopharmacological Bulletin, 14*, 39-40.

Goyette, C. H., Conners, C. K., & Ulrich, R. F. (1978). Normative data on revised Conners parent and teacher rating scales. *Journal of Abnormal Child Psychology, 6*, 221-236.

Graetz, B. W., Sawyer, M., Hazell, P. L., Arney, F., & Baghurst, P. (2001). Validity of DSM-IV ADHD representative sample of Australian children and adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*(12), 1410-1417.

Gray, J. A. (1975). *Elements of a two-process theory of learning.* London: Academic Press.

Gray, J. A. (1982). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system.* NewYork: Oxford University Press.

Gray, J. A. (1987). *The psychology of fear and stress* (2nd ed.). Cambridge, England: Cambridge University Press.

Greenbaum, P. E., Dedrick, R. F., Prange, M. E., & Friedman, R. M. (1994). Parent, teacher, and child ratings of problem behaviors of youngsters with serious emotional disturbances. *Psychological Assessment, 6*, 141-148.

Grennell, M. M., Glass, C. R., & Katz, K. S. (1987). Hyperactive children and peer interaction: *Knowledge and Performance of Social Skills. 15*, 1-13.

Grodzinsky, G. M., & Diamond, R. (1992). Frontal lobe functioning in boys with attention deficit hyperactivity disorder. *Developmental Neuropsychology, 8*, 427-445.

Gross, M. D., Tofanelli, R., Snodgrass, E. W., & Butzirus, S. M. (1987). The effects of diets rich in and free from additives on the behavior of children with hyperkinetic and learning disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 53-55.

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1999). *Multivariate data analysis*. Upper Saddle River, NJ: Prentice Hall.

Halperin, J. M., Matier, K., Bedi, G., Sharma, V., & Newcorn, J. H. (1992). Specificity of inattention, impulsivity and hyperactivity to the diagnosis of attention-deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 190-196.

Halperin, J. M., O'Brien, B. S., & Newcorn, J. (1990). Validation of hyperactive, aggressive, and mixed hyperactive/aggressive childhood disorder: A research note. *Journal of Child Psychology and Psychiatry, 31*, 455-459.

Harley, J. P., Matthews, C. G., & Eichman, P. (1978). Synthetic food colors and hyperactivity in children: a double blind challenge experiment. *Pediatrics, 62*, 975-983.

Hart, E. L., Lahey, B. B., Loeber, R., Applegate, B., & Frick, P. R. (1995). Developmental change in attention-deficit hyperactivity disorder in boys: A four year longitudinal study. *Journal of Abnormal Child Psychology, 23*, 729-749.

Hartup, W. W. (1974). Aggression in childhood: Developmental perspectives. *American Psychologist, 29*, 336-341.

Harvey, E., Danforth, J. S., Ulaszek, W. R., & Eberhardt, T. L. (2001). Validity of the parenting scale for parents of children with attention-deficit/hyperactivity disorder. *Behaviour Research and Therapy, 39*, 731-743.

Healey, J. M., Newcorn, J. H., Halperin, J. M., & Wolfe, L. E. (1993). The factor structure of ADHD items in DSM-III-R: Internal consistency and external validation. *Journal of Abnormal Child Psychology, 21*, 441-453.

Hechtman, L. (1985). Adolescent outcomes of hyperactive children treated with stimulants in childhood: A review. *Psychopharmacology Bulletin, 21*, 178-191.

Hechtman, L. (1996). Families of children with attention deficit hyperactivity disorder: A review. *Canadian Journal of Psychiatry, 41*, 350-360.

Heilman, K. M., Voeller, K. K., & Naidu, S. E. (1991). A possible pathophysiologic substrate of attention deficit hyperactivity disorder. *Journal of Child Neurology, 6*(Suppl. 76-Suppl. 81).

Herbert, M. (1964). The concept and testing of brain damage in children: A review. *Journal of Child Psychology and Psychiatry, 5*, 197-217.

Herrera-Graf, M., Dipert, Z. J., & Hinton, R. N. (1996). Exploring the effective use of the vocabulary-block design short-form with a special school population. *Educational and Psychological Measurement, 36*, 522-528.

Herrero, M. E., Hechtman, L., & Weiss, G. (1994). Antisocial disorders in hyperactive subjects from childhood to adulthood: Predictive factors and characteristics of subgroups. *American Journal of Orthopsychiatry, 64*, 510-521.

Hewitt, J. K., Silberg, J. L. & Neale, M. C. (1992). The analysis of parental ratings of childrens' behavior using LISREL. *Behavior Genetics, 22*(3), 295-317.

Hill, J., & Schoener, E. (1996). Age-dependent decline of attention-deficit hyperactivity disorder. *American Journal of Psychiatry, 153*, 1143-1146.

Hinshaw, S. P. (1987). On the distinction between attentional deficit/hyperactivity and conduct problems/aggression in childhood psychopathology. *Psychological Bulletin, 101*, 443-463.

Hinshaw, S. P. (1994). *Attention deficits and hyperactivity in children.* Thousand Oaks, CA: Sage.

Hinshaw, S. P., Buhrmeister, D., & Heller, T. (1989). Anger control in response to verbal provocation: Effects of stimulant medication for boys with ADHD. *Journal of Abnormal Child Psychology, 17*, 393-407.

Hinshaw, S. P., & Erhardt, D. (1990). Behavioral treatment of attention-deficit hyperactivity disorder. In V. B. Van Hasselt & M. Hersen (Eds.), *Handbook of behavior therapy and pharmacotherapy for children: An integrative approach*. New York: Plenum.

Hinshaw, S. P., Heller, T., & McHale, J. P. (1992). Covert antisocial behavior in boys with attention deficit hyperactivity disorder: External validation and effects of methylphenidate. *Journal of Consulting and Clinical Psychology, 60*, 274-281.

Hinshaw, S. P., Henker, B., Whalen, C. K., Erhardt, D., & Dunnington, R. E. (1989). Aggressive, prosocial, and nonsocial behavior in hyperactive boys: Dose effects of methylphenidate in naturalistic settings. *Journal of Consulting and Clinical Psychology, 57*, 636-643.

Hinshaw, S. P., & McHale, J. P. (1991). Stimulant medication and the social interactions of hyperactive children. In D. G. Gilbert & J. J. Connolly (Eds.), *Personality, social skills, and psychopathology: An individual differences approach*. New York: Plenum.

Hoelter, J. W. (1983). The analysis of covariance structures: Goodness-of-fit indices. *Sociological Methods and Research, 11*, 325-344.

Hohman, L. B. (1922). Post-encephalitic behavior disorder in children. *John Hopkins Hospital Bulletin, 33*, 372-375.

Holborow, P. L., & Berry, P. S. (1986). Hyperactivity and learning difficulties. *Journal of Learning Disabilities, 19*, 426-431.

Holcomb, P. J., Ackerman, P. T., & Dykman, R. A. (1985). Cognitive event-related brain potentials in children with attention and reading deficits. *Psychophysiology, 22*, 656-667.

Holland, M. L., Gimpel, G. A., & Merrell, K. W. (1998). Innovations in assessing ADHD: Development, psychometric properties, and factor structure of the ADHD Symptoms Rating Scale (ADHD-SRS). *Journal of Psychopathology and Behavioral Assessment, 20*, 307-332.

Houghton, S., Douglas, G. D., West, J., Whiting, K., Wall, M., Langsford, S., et al. (1999). Differential patterns of executive function in children with attention-deficit hyperactivity disorder according to gender and subtype. *Journal of Child Neurology, 14*, 801-806.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.). *Structural equation modeling: Concepts, issues, and applications* (pp. 158-176). Thousand Oaks, CA: Sage

Hu, H., & Bentler, P. M., & Kano, Y. (1992). Can test statistics in covariance structure analysis be trusted? *Psychological Bulletin, 112*, 351-362.

Hubbard, J. A., Dodge, K. A., Cilleson, A. H., Coie, J. D., & Schwartz, D. (2001). The dyadic nature of social information processing in boys' reactive and proactive aggression. *Journal of Personality and Social Psychology, 80*, 268-280

Hudziak, J. J., Heath, A. C., Madden, P. C., Reich, W., Bucholz, K., Slutzke, W., et al. (1998). Latent class and factor analysis of DSM-IV ADHD: A twin study of female adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 848-857.

Hughes, J. R., & John, E. R. (1999). Conventional and quantitative electroencephalography in psychiatry. *Journal of Neuropsychiatry and Clinical Neurosciences, 11*, 190-208.

Hunt, R. D. (1987). Treatment effects of oral and transdermal clonidine in relation to methylphenidate: An open pilot study in ADD-H. *Psychopharmacology Bulletin, 23*, 111-114.

Hunt, R. D., Capper, L., & O'Connell, P. (1990). Clonidine in child and adolescent psychiatry. *Journal of Child and Adolescent Psychopharmacology, 1*, 87-101.

Hunt, R. D., Minderaa, R. B., & Cohen, D. J. (1985). Clonidine benefits children with attention deficit disorder and hyperactivity: Report of a double blind placebo- crossover therapeutic trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 24*, 617- 629.

Hunt, R. D., Minderaa, R. B., & Cohen, D. J. (1986). The therapeutic effect of clonidine in attention deficit with hyperactivity: A comparison with placebo and methylphenidate. *Psychopharmacology Bulletin, 22*, 229-236.

Hutchinson, E., Pearson, D., Fitzgerald, C., Bateman, B., Grant, C., Grundy, J., et al. (2001). Can parents accurately perceive hyperactivity in their child? *Child Care Health and Development, 27*, 241-250,

Hynd, G. W., Lorys, A. R., Semrud-Clikeman, M., Nieves, N., Huettner, M., & Lahey, B. B. (1991). Attention deficit disorder without hyperactivity: A distinct behavioral and neurocognitive syndrome. *Journal of Child Neurology, 6*(Suppl. 37-Suppl. 43).

Iaboni, F., Douglas, V. I., & Baker, A. G. (1995). Effects of reward and response costs on inhibition in ADHD children. *Journal of Abnormal Psychology, 104*, 232-240.

Jennings, J. R., van der Molen, M. W., Pelham, W., Brock-Debski, K., & Hoza, B. (1997). Inhibition in boys with attention deficit hyperactivity disorder as indexed by heart rate change. *Developmental Psychology, 33*, 308-318.

Jensen, P., Martin, D., & Cantwell, D. P. (1997). Comorbidity in ADHD: Implications for research practice and DSM-IV. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1065-1079.

Jensen, P. S., Rubio-Stipec, M., Canino, G., Bird, H. R., Dulcan, M. A., Schwab-Stone, et al. (1999). Parent and child contributions to diagnosis of mental disorders: Are both informants necessary? *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 1569-1579.

Jensen, P. S., Shervette, R. E., Xenakis, S. N., & Richters, J. (1993). Anxiety and depressive disorders in attention deficit disorder with hyperactivity: New findings. *American Journal of Psychiatry, 150*, 1203-1209.

Johnston, C. (1996). Parent characteristics and parent-child interactions in families of nonproblem children and ADHD children with higher and lower levels of oppositional-defiant behavior. *Journal of Abnormal Child Psychology, 24*, 85-104.

Johnston, C., & Mash, E. J. (2001). Families of children with attention-deficit/hyperactivity disorder: Review and recommendations for future research. *Clinical Child and Family Psychology Review, 4*, 183-207.

Johnston, C., Murray, C., Hinshaw, S. P., Pelham, W. E., & Hoza, B. (2002). Responsiveness in interactions of mothers and sons with ADHD: Relations to maternal and child characteristics. *Journal of Abnormal Child Psychology, 30*(1), 77-88.

Johnstone, S. J., Barry, R. J., & Anderson, J. W. (2001). Topographic distribution and developmental timecourse of auditory event-related potentials in two subtypes of attention-deficit hyperactivity disorder. *International Journal of Psychophysiology, 42*, 73-94.

Joreskog, K. G., & Sorbom, D. (1996). *LISREL 8: User's reference guide.* Chicago: Scientific Software International Inc.

Joreskog, K. G., & Sorbom, D. (2001). *LISREL 8.51: User's reference guide.* Chicago: Scientific Software International Inc.

Kahn, E., & Cohen, L. H. (1934). Organic driveness: A brain stem syndrome and an experience. *New England Journal of Medicine, 210*, 748-756.

Kaufman, A .S., & Kaufman, N. L. (1985). *Kaufman Test of Educational Achievement (K-TEA).* Circle Pines, MN: American Guidance Service

Kazdin, A. E. (1996). Problem solving and parent management in treating aggressive and antisocial behavior. In E. Hibbs & P. Jensen (Eds.), *Psychosocial treatments for child and adolescent disorders: Empirically based treatments for clinical practice.* Washington, DC: American Psychological Association.

Kelloway, E. K. (1998). *Using LISREL for structural equation modeling: A researchers guide.* London: Sage.

Kendall, P. (1991). *Child and adolescent therapy: Cognitive-behavioral procedures.* New York: Guilford.

Kenny, D. A., & Kashy, D. A. (1992) The analysis of the multitrait-multimethod matrix for confirmatory factor analysis. *Psychological Bulletin, 112*, 165-172.

King, C., & Young, R. D. (1982). Attentional deficits with and without hyperactivity: Teacher and peer perceptions. *Journal of Abnormal Child Psychology, 10*, 483-495.

Kirby, E. A., & Grimley, L. K. (1986). *Understanding and treating attention deficit disorders*. Elmsford, NY: Pergamon.

Kirk, S. A. (1963). Behavioral diagnoses and remediation of learning disabilities. In *Proceedings of the annual meeting: Conference on exploration into the problems of the perceptually handicapped child*, (Vol. 1, pp.1-7). Evanston, Illinois.

Klein, R. G., & Mannuzza, S. (1991). Long-term outcome of hyperactive children: A review. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 383-387.

Klorman, R., Brumaghim, J. T., Fitzpatrick, P. A., Borgstedt, A. D., & Strauss, J. (1994). Clinical and cognitive effects of methylphenidate on children with attention deficit disorder as a function of aggression/oppositionality and age. *Journal of Abnormal Psychology, 103*, 206-221.

Klorman, R., Coons, H. W., & Borgstedt, A. D. (1987). Effects of methylphenidate on adolescents with a childhood history of attention deficit disorder: I. Clinical findings. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 363-367.

Klorman, R., Hazel-Fernandez, L., Shaywitz, S. E., Fletcher, J. M., Marchione, K. E., Holahan, J., et al. (1999). Executive functioning deficits in attention-deficit/hyperactivity disorder are independent of oppositional defiant or reading disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*(9), 1148-1155.

Krusch, D. A., Klorman, R., Brumaghim, J. T., Fitzpatrick, P. A., Borgstedt, A. D., & Strauss, J. (1996). Methylphenidate slows reactions of children with attention deficit disorder during and after an error, *Journal of Abnormal Child Psychology, 24*, 633-650.

Kuperman, S., Johnson, B., Arndt, S., Lingren, S., & Wolraich, M. L. (1996). Quantitative EEG differences in a non-clinical sample of children with ADHD and undifferentiated ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 1009-1017.

Lahey, B. B., Applegate, B., McBurnett, K., Biederman, J., Greenhill, L., Hynd, G. W., et al. (1994). DSM-IV field trials for attention deficit hyperactivity disorder in children and adolescents. *American Journal of Psychiatry, 151*(11), 1673-1685.

Lahey, B. B., & Carlson, C. L. (1991). Validity of the diagnostic category of attention deficit disorder without hyperactivity: A review of the literature. *Journal of Learning Disabilities, 24*, 110-120.

Lahey, B. B., Carlson, C. L., & Frick, P. R. (1997). Attention deficit disorder without hyperactivity: A review of research relevant to DSM-IV. In T. A. Widiger., A. J. Frances., W. Davis, & M. First (Eds.), *DSM-IV source book Vol. I.* Washington, DC: American Psychiatric Press.

Lahey, B. B., Loeber, R., Stouthamer-Loeber, M., Christ, M. A., Green, S., Russo, M. F., et al. (1990). Comparison of DSM-III and DSM-III-R diagnoses for prepubertal children: Changes in prevalence and validity. *Journal of the American Academy of Child and Adolescent Psychiatry, 27*, 330-335.

Lahey, B. B., Pelham, W. E., Schaughency, E. A., Atkins, M. A., Murphy, H. A., Hynd, G., et al. (1988). Dimensions and types of attention deficit disorder.

Journal of the American Academy of Child and Adolescent Psychiatry, 26, 718-723.

Lahey, B. B., Pelham, W. B., Stein, M. A., Loney, J., Trapani, C., Nugent, K., et al. (1998). Validity of attention-deficit hyperactivity disorder for younger children. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 695-702.

Lahey, B. B., Schaughency, E. A., Frame, C. L., & Strauss, C. C. (1985). Teacher ratings of attention problems in children experimentally classified as exhibiting attention deficit disorders with and without hyperactivity. *Journal of the American Academy of Child and Adolescent Psychiatry, 24*, 613-616.

Lahey, B. B., Schaughency, E., Hynd, G., Carlson, C., & Nieves, N. (1987). Attention deficit disorder with and without hyperactivity: Comparison of behaviouralcharacteristics of clinic-referred children. *Journal of the American Academy of Child Psychiatry, 26*, 718-723.

Lahey, B. B., Schaughency, E. A., Strauss, C. C., & Frame, C. L. (1984). Are attention deficit disorders with and without hyperactivity similar or dissimilar disorders? *Journal of the American Academy of Child and Adolescent Psychiatry, 23*, 302-309.

Lalonde, J., Turgay, A., & Hudson, J. I. (1998). Attention-deficit hyperactivity disorder subtypes and comorbid disruptive behavior disorders in a child and adolescent mental health clinic. *Canadian Journal of Psychiatry, 43*, 623-628.

Lambert, N. M. (1988). Adolescent outcomes for hyperactive children. *American Psychologist, 43*, 786-799.

Lamminmaki, T., Ahonen, T., Narhi, V., & Lyytinen, H. (1995). Attention deficit hyperactivity disorder subtypes: Are there differences in academic problems? *Developmental Neuropsychiatry, 11*(3), 297-310.

Lance. C. E., Noble, C. L., & Scullen, S. E. (2002). A critique of the correlated method and correlated uniqueness models for multitrait-multimethod data. *Psychological Method, 2*, 228-244.

Laufer, M., & Denhoff, E. (1957). Hyperkinetic behavior in children. *Journal of Pediatrics, 50*, 463-474.

Le Doux, J. E. (1995). Emotion: Clues for the brain. *Annual Review of Psychology, 46*, 209-235. Lemerise, E. A., & Arsenio, W. F. (2000). An integrated model of emotion processes and cognition in social information processing, *Child Development, 71*, 107-118.

Levin, P. M. (1938). Restlessness in children. *Archives of Neurology and Psychiatry, 39*, 764-770.

Levine, M. D. (1987). Attention deficits: The diversive effects of weak control systems in childhood. *Pediatric Annals, 16*, 117-130.

Levy, F. (2000). Implications for Australia of the multimodal treatment study of children with attention-deficit hyperactivity disorder. *Australian and New Zealand Journal of Psychiatry, 35, 45-48*

Levy, F., Hay, D. A., McStephen, M., Wood, C., & Waldman, I. (1997). Attention-deficit hyperactivity disorder: A category or a continuum? Genetic analysis of a large-scale twin study. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 737-744.

Levy, P. (1967). Short-form tests: A methodological review. *Psychological Bulletin, 69*, 410-416.

Lewis, K. (1992). Family functioning as perceived by parents of boys with attention deficit disorder. *Issues in Mental Health Nursing, 13*, 369-386.

Lindahl, K. M. (1998). Family process variables and children's disruptive behavior problems. *Journal of Family Psychology, 12*, 420-436.

Livingston, R., Dykman, R. A., & Ackerman, J. (1990). The frequency and significance of additional self-reported psychiatric diagnoses in children with attention deficit disorder. *Journal of Abnormal Child Psychology, 18*, 465-478.

Lochman, J. E. (1992). Cognitive behavior intervention with aggressive boys: Three-year follow up and preventive effects. *Journal of Consulting and Clinical Psychology, 60*, 426-432.

Lochman, J. E., & Lenhart, L. A. (1993). Anger coping intervention for aggressive children: Conceptual models and outcome effects. *Clinical Psychology Review, 13*, 785-805.

Lockwood, K. A., Marcotte, A. C., & Stern, C. (2001). Differentiation of attention deficit/hyperactivity disorder subtypes: Application of a neuropsychological model of attention. *Journal of Clinical and Experimental Neuropsychology, 23*, 317-330.

Loeber, R., & Schmaling, K. (1985). Empirical evidence for overt and covert patterns of antisocial conduct problems. *Journal of Abnormal Child Psychology, 13*, 337-352.

Loevinger, J. (1957). Objective tests as instruments of psychological theory. *Psychological Reports, 3*, 635-694.

Logan, G. D., Cowan, W. B., & Davis, K. B. (1984). The ability to inhibit simple and choice reaction time responses: A model and a method. *Journal of Experimental Psychology: Human Perception and Performance, 10*, 276-291.

Loney, J., Langhorne, J. E., & Paternite, C. E. (1978). An empirical basis for subgrouping the hyperkinetic syndrome. *Journal of Abnormal Psychology, 87*, 431-441. Loney, J., & Milich, R. S. (1981). Hyperactivity, inattention, and aggression in clinical practice. In M. M. Wolraich & D. K. Routh (Eds.), *Advances in behavioral pediatrics* (Vol. 2). Greenwich, CT: JAI Press.

Loney, J., & Milich, R. S. (1982). Hyperactivity, inattention, and aggression in clinic practice. In M. M. Wolraich & D. K. Routh (Eds.), *Advances in developmental and behavioral pediatrics* (Vol. 3, pp. 113-147). Greenwich, CT: JAI Press.

Lord, E. E. (1937). *Children handicapped by cerebral palsy*. New York: Commonwealth Fund.

Lorenz, K. (1966). *On aggression*. New York: Harcourt Brace and World.

Losier, B. J., McGrath, P. J., & Klein, R. M. (1996). Error patterns on the continuous performance in non-medicated and medicated samples of children with and without ADHD: A meta-analytic review. *Journal of Child Psychology and Psychiatry, 37*, 971-987.

Lou, H. C., Hendrickson, L., & Bruhn, P. (1984). Focal hypoperfusion in children with dysphasia and/or attention deficit disorder. *Archives of Neurology, 41*(8), 48-52.

Lou, H. C., Hendrickson, L., Bruhn, P., Borner, H., & Nielsen, J. B. (1989). Striatal dysfunction in attention deficit and hyperkinetic disorder. *Archives of Neurology, 46*(1), 48-52.

Luria, A. R. (1969). *Higher cortical functions in man and their impairment in local lesions of the brain* (2nd ed.). Moscow: Moscow University Press.

Lynskey, M. T., & Fergusson, D. M. (1995). Childhood conduct problems, attention deficit behaviors, and adolescent alcohol, tobacco, and illicit drug use. *Journal of Abnormal Child Psychology, 23*, 281-288.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130-149.

Maccoby, E. E., & Martin, J. A. (1983). Socialisation in the context of the family: Parent-child interaction. In E. M. Hetherington (Ed.), *Handbook of child psychology: Socialisation, personality, and social development* (Vol. 4, pp. 1-101). New York: Wiley.

Magnusson, P., Smari, J., Gretarsdottir, H., & Brandardottir, H. (1999). Attention-deficit/hyperactivity symptoms in Icelandic schoolchildren: Assessment with the attention deficit/hyperactivity rating scale-iv. *Scandinavian Journal of Psychology, 40*, 301-306.

Mannuzza, S., Klein, R. G., Bonagura, N., Malloy, P., Giampino, T. L., & Addalli, K. (1991). Hyperactive boys almost grown up: V. Replication of psychiatric status. *Archives of General Psychiatry, 48*, 77-83.

Mariani, M. A., & Barkley, R. A. (1997). Neuropsychology and academic functioning in preschool boys with attention deficit hyperactivity disorder. *Developmental Neuropsychology, 13*, 111-129.

Marsh, D. T. (1982). The development of interpersonal problem solving among elementary school children. *Journal of Genetic Psychology, 140*, 107-118.

Marshall, R. M., Schafer, V. A., O'Donnell, L., Elliott, J., & Handwerk, M. L. (1999). Arithmetic disabilities and ADD subtypes. *Journal of Learning Disabilities, 32*(3), 239-247.

Mash, E. J. & Barkley, R. A. (Eds.), (1996). *Child psychopathology*. NewYork: Guilford.

Mash, E. J., & Daiby, J. T. (1979). Behavioral interventions for hyperactivity. In R. T. Trites (Ed.), *Hyperactivity in children: Aetiology, measurement, and treatment implication*. Baltimore: University Park Press.

Mash, E. J., & Johnston, C. (1983). Parental perceptions of child behavior problems, parenting self-esteem, and mothers' reported stress in younger and older hyperactive and normal children. *Journal of Consulting and Clinical Psychology, 51*, 86-99.

McBurnett, K. (1994). Attention-deficit hyperactivity disorder: Review of assessment issues for DSM-IV. In T. A. Widiger, A. J. Frances, & D. Shaffer (Eds.), *DSM-IV source book, vol.4, literature reviews.* Washington, DC: American Psychiatric Press.

McBurnett, K. (1997). Attention-deficit hyperactivity disorder: A review of diagnostic issues. In T. A. Widiger, A. J. Frances, H. A. Pincus, R. Ross, M. First, & W. Davis (Eds.), *DSM-IV source book* (Vol. 3, pp. 111-143). Washington, DC: American Psychiatric Association.

McBurnett, K., Pfiffner, L. J., & Frick, P. J. (2001). Symptom properties as a function of ADHD type: An argument for continued study of sluggish cognitive tempo. *Journal of Abnormal Child Psychology, 29*(3), 207-213.

McBurnett, K., Pfiffner, L. J., Willcutt, E., Tamm, L., Lerner, M., Ottolini, Y. L., et al. (1999). Experimental cross-validation of DSM-IV types of attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*(1), 17-24.

McGee, R., Williams, S., Moffitt, T. E., & Anderson, J. C. (1989). A comparison of 13 year-old boys with attention deficit and/or reading disorder on neuropsychological measures. *Journal of Abnormal Child Psychology, 17*, 37-53.

McGee, R., Williams, S., & Silva, P. A. (1984a). Behavioral and developmental characteristics of aggressive, hyperactive, and aggressive-hyperactive boys. *Journal of the American Academy of Child and Adolescent Psychiatry, 23*, 270-279.

McGee, R., Williams, S., & Silva, P. A. (1984b). Background characteristics of aggressive, hyperactive, and aggressive hyperactive boys. *Journal of the American Academy of Child and Adolescent Psychiatry, 23*, 280-284.

McGee, R., Williams, S., Bradshaw, J., Chapel, J. A., Robins, A., & Silva, P. A. (1985). The Rutter Scale for completion by teachers: factor structure and relationships with cognitive abilities and family adversity for a sample of New Zealand children. *Journal of Child Psychology and Psychiatry, 26*, 727-739.

Meesters, C., Muris, P., & Esselink, T. (1995). Hostility and perceived parental rearing behaviour. *Personality and Individual Differences, 18*, 567-570.

Mick, E., Biederman, J., Faraone, S. V., Sayers, J., & Kleinman, S. (2002). Case-control study of attention-deficit hyperactivity disorder and maternal smoking, alcohol use, and drug use during pregnancy. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*,378-385.

Milberger, S., Biederman, J., Faraone, S. V., Chen, L., & Jones, J. (1996). Is maternal smoking a risk factor for attention-deficit hyperactivity disorder in children? *American Journal of Psychiatry, 153*, 1138-1142.

Milberger, S., Biederman, J., Faraone, S. V., Guite, J., & Tsuang, M. T. (1997). Pregnancy, delivery and infancy complications and attention-deficit hyperactivity disorder: issues of gene-environment interaction. *Biological Psychiatry, 41*, 65-75.

Milberger, S., Biederman, J., Faraone, S. V., & Jones, J. (1998). Further evidence of an association between maternal smoking during pregnancy and attention-deficit hyperactivity disorder: findings from a high risk sample of siblings. *Journal of Clinical Child Psychology, 27*, 352-358.

Milich, R., Balentine, A. C., & Lynam, D. R. (2001). ADHD combined type and ADHD predominantly inattentive type are distinct and unrelated disorders. *Clinical Psychology; Science and Practice, 8*, 463-488.

Milich, R., Carlson, C. L., Pelham, W. E., & Licht, B. G. (1991). Attention-deficit hyperactivity disordered boys' evaluations of and attributions for task performance on medication versus placebo. *Journal of Abnormal Psychology, 98*, 280-284.

Milich, R., & Dodge, K. A. (1984). Social information processing in child psychiatric populations. *Journal of Abnormal Child Psychology, 12*, 471-490.

Milich, R., Hartung, C. M., Martin, C. A., & Haigler, E. D. (1994). Behavioral disinhibition and underlying processes in adolescents with disruptive behavior disorders. In D. K. Routh (Ed.), *Disruptive behavior disorders in childhood* (pp. 109-138). New York: Guilford.

Milich, R., Licht, B. G., Murphy, D. A., & Pelham, W. E. (1989). Attention-deficit hyperactivity disordered boys' evaluations of and attributions for task performance on medication versus placebo. *Journal of Abnormal Child Psychology, 98*, 280-294.

Milich, R., Widiger, T. A., & Landau, S. (1987). Differential diagnosis of attention deficit and conduct disorders using conditional probabilities. *Journal of Consulting and Clinical Psychology, 55*, 762-767.

Millichap, J. G. (1997). Temporal lobe arachnoid cyst-attention deficit disorder syndrome: Role of the electroencephalogram in diagnosis. *Neurology, 48*, 1435-1439.

Milner, B. (1995). Aspects of human frontal lobe function. In H. H. Jasper, S. Riggio, & P. S Goldman-Rakic (Eds.), *Epilepsy and the functional anatomy of the frontal lobe*. New York: Raven Press.

Miranda, A., & Presentacion, M. J. (2000). Efficacy of cognitive-behavioral treatment of children with ADHD, with and without aggressiveness. *Psychology in the Schools, 37*(2), 169-182.

Mitsis, E. M., McKay, K. E., Schulz, K. P., Newcorn, J. H., & Halperin, J. M. (2000). Parent-teacher concordance for DSM-IV attention-deficit/hyperactivity disorder in a clinic-referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*, 308-313.

Molina, B. S., Smith, B. H., & Pelham, W. E. (2001). Factor structure and criterion validity of secondary school teacher ratings of ADHD and ODD. *Journal of Abnormal Child Psychology*, *29*, 71-82.

Morgan, A. E., Hynd, G. W., Riccio, C. A., & Hall, J. (1996). Validity of DSM-IV ADHD predominantly inattentive and combined types: Relationship to previous DSM diagnoses/subtype differences. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 325-333.

Morrison, J., & Stewart, M. (1971). A family study of hyperactive child syndrome. *Biological Psychiatry, 3*, 189-195.

Mulaik, S. A., James, L. R., & Van Alstine, J. (1989). Evaluation of goodness of fit indices for structural equation models. *Psychological Bulletin, 105*, 430-445.

Muris, P., Bogels, S., Meesters, C., van der Kamp, N., & van Oosten, A. (1996). Parental rearing practices, fearfulness, and problem behaviour in clinically-referred children. *Personality and Individual Differences, 21*, 813-818.

Murphy, K., & Barkley, R. A. (1996). Prevalence of DSM-IV symptoms of ADD and adult licensed drivers: Implications for clinical diagnosis. *Journal of Attention Disorders, 1*, 147-161.

Muthen, L. K., & Muthen, B. O. (1998). *Mplus User's Guide*. Los Angeles, CA: Muthen & Muthen.

Needleman, H. L., Gunnoe, C., Leviton, A., Reeds, R., Peresie, H., Maher, C., et al. (1979). Deficits in psychologic and classroom performance with elevated dentine lead levels. *New England Journal of Medicine, 300*, 689-695.

Newcorn, J. H., Halperin, J. M., Healey, J. M., O'Brien, J. D., Pascualvaca, D., Wolf, L. E., et al. (1989). Are ADDH and ADHD the same or different? *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 734-738.

Newman, J. P. (1987). Reaction to punishment in extraverts and psychopaths: Implications for the impulsive behavior of disinhibited individuals. *Journal of Research in Personality, 21*, 464-480.

Nigg, J. T. (1999). The ADHD response inhibition deficit as measured by the Stop Task: replication with DSM-IV combined type, extension, and qualification. *Journal of Abnormal Child Psychology, 27*, 391-400.

Nigg, J. T., Blaskey, G. T., Huang-Pollock, C. L., & Rappley, M. D. (2002). Neuropsychological executive functions and DSM-IV ADHD subtypes. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*, 59-66.

Nigg, J. T., & Hinshaw, S. P. (1998). Parent personality traits and psychopathology associated with antisocial behaviors in childhood attention-deficit hyperactivity disorder. *Journal of Child Psychology and Psychiatry, 39*, 145-159.

Nolan, E., Gadow, K. D., & Sprafkin, J. (2001). Teacher reports of DSM-IV ADHD, ODD, and CD symptoms in schoolchildren. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*, 241-249.

Nolan, E., Volpe, R. J., Gadow, K. D., & Sprafkin, J. (1999). Developmental, gender, and comorbidity differences in clinically referred children with ADHD. *Journal of Emotional and Behavioral Disorders, 7*, 11-20.

O'Brien, B. S., & Frick, P. J. (1996). Reward dominance: Associations with anxiety, conduct problems, and psychopathy in children. *Journal of Abnormal Child Psychology, 24*, 223-240.

Offord, D. R., Boyle, M. H., Szatmari, P., Rae-Grant, N., Links, P. S., Cadman, D. T., et al. (1987). Ontario child health study: II. Six month prevalence of disorder and rates of service utilisation. *Archives of General Psychiatry, 44*, 832-836.

Olweus, D. (1979). Stability of aggressive reaction patterns in males: A review. *Psychological Bulletin, 86*, 852-875.

Oosterlaan, J., & Sergeant, J. A. (1995). Response choice and inhibition in ADHD, anxious, and aggressive children: The relationship between S-R compatibility and the stop signal task. In J. A. Sergeant (Ed.), *Eunethydis: European approaches to hyperkinetic disorder.* Amsterdam: Author.

Oosterlaan, J., & Sergeant, J. A. (1998). Effects of reward and response cost on response inhibition in AD/HD, disruptive, anxious, and normal children. *Journal of Abnormal Child Psychology, 26*, 161-174.

Ornoy, A., Michailevskaya, V., Lukashov, I., Bar-Hamburger, R., & Harel, S. (1996). The developmental outcome to children born to heroin dependent mothers, raised at home or adopted. *Child Abuse and Neglect, 20*, 385-396.

Ostrander, R., Weinfurt, K. P., Yarnold, P. R., & August, G. J. (1998). Diagnosing attention deficit disorders with the behavioral assessment system for children and the child behavior checklist: Test and construct validity analyses using optimal discriminant classification trees. *Journal of Consulting and Clinical Psychology, 66*, 660-672.

Paternite, C. E., Loney, J., & Roberts, M. A. (1996). A preliminary validation of subtypes of DSM-IV attention-deficit/hyperactivity disorder. *Journal of Attention Disorders, 1*(2), 70-86.

Patterson, G. R. (1982). *The coercive family process*. Eugene, OR: Castalia.

Pelham, W. E., & Bender, M. E. (1982). Peer relationships in hyperactive children: Description and treatment. In K. D. Gadow & I. Bialer (Eds.), *Advances in learning and behavioral disabilities.* (Vol. 1). Greenwich, CT: JAI Press.

Pelham, W. E., Bender, M. E., Caddell, J., Booth, S., & Moorer, S. (1985). The dose-response effects of methylphenidate on classroom academic and social behavior in children with attention-deficit disorder. *Archives of General Psychiatry, 42*, 948-952.

Pelham, W. E., Evans, S. E., Gnagy, E. M., & Greenslade, K. E. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders: Prevalence, factor analyses, and conditional probabilities in a special education sample. *School Psychology Review, 21*, 285-299.

Pelham, W. E., Gnagy, E., Greenslade, K. E., & Milich, R. (1992). Teacher ratings of DSM-III symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 210-218.

Pelham, W. E., & Hoza, B. (1996). Intensive treatment: A summer treatment program for children with ADHD. In E. Hibbs & P. Jensen (Eds.), *Psychosocial treatments for child and adolescent disorders: Empirically based strategies for clinical practice.* New York: American Psychological Association.

Pelham, W. E., & Murphy, H. A. (1986). Behavioral and pharmacological treatment of hyperactivity and attention-deficit disorders. In M. Herson & S. E. Breuning (Eds.), *Pharmacological and behavioral treatment: An integrative approach*. New York: Wiley.

Pelham, W. E., Swanson, J. M., Furman, M. B., & Schwindt, H. (1995). Pemoline effects of children with ADHD: A time-response by dose-response analysis on classroom measures. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 1504-1513.

Pelham, W. E., & Waschbusch, D. A. (1999). Behavioral interventions in ADHD. In H. C. Quay & A. E. Hogan (Eds.), *Handbook of disruptive behavior disorders* (pp. 255-278). London: Kluwer Academic/Plenum Press.

Perris, C., Jacobson, L., Lindstrom, H., Van Knorring, L., & Perris, H. (1980). Development of a new inventory for assessing measures of parental rearing behaviour. *Acta Psychologica Scandanavica, 61*, 265-274.

Pfiffner, L. J., & McBurnett, K. (1997). Social skills training with parent generalisation: Treatment effects for children with ADD/ADHD. *Journal of Consulting and Clinical Psychology, 65*, 749-757.

Piacentini, J., Shaffer, D., Fisher, P., Schwab-Stone, M., Davies, M., & Gioia, P. (1993). The Diagnostic Interview Schedule for Children-Revised Version (DISC- R). III: Concurrent criterion validity. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 658-665.

Pillow, D. R., Pelham, W. E., Hoza, B., Molina, B. S., & Stultz, C. H. (1998). Confirmatory factor analyses examining attention deficit hyperactivity disorder symptoms and other childhood disruptive behaviors. *Journal of Abnormal Child Psychology, 26*, 293-309.

Pliszka, S. R. (1989). Effect of anxiety on cognition, behavior, and stimulant response in ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 28*, 882-887.

Pliszka, S. R., Carlson, C. L., & Swanson, J. M. (1999). *ADHD with comorbid disorders: clinical assessment and management.* London: Guilford.

Poulin, F., & Bouvin, M. (2000). Reactive and proactive aggression: Evidence of a two-factor model. *Psychological Assessment, 12*, 115-122.

Power, T. J., Andrews, T. J., Eiraldi, R. B., Doherty, B. J., Ikeda, M. J., DuPaul, G. J., et al. (1998). Evaluating attention deficit hyperactivity disorder using multiple informants: The incremental utility of combining teacher with parent reports. *Psychological Assessment, 10*, 250-260.

Preston, M. L. (1945). Late behavioral aspects found in cases of prenatal, natal, and postnatal anoxia. *Journal of Pediatrics, 26*, 353-366.

Price, J., & Dodge, K. A. (1989). Reactive and proactive aggression in childhood: Relations to peer status and social context dimensions. *Journal of Abnormal Child Psychology, 17*, 455-471.

Prince, J. B., Wilens, T. B., Biederman, J., Spencer, T. J., & Wozniak, J. R. (1996). Clonidine for sleep disturbances associated with attention-deficit hyperactivity disorder: A systematic chart review of 62 cases. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 599-605.

Prinz, R. J., Roberts, W. A., & Hantman, E. (1980). Dietary correlates of hyperactive behavior in children. *Journal of Consulting and Clinical Psychology, 48*, 760-769.

Prout, H. T. (1977). Behavioral intervention with hyperactive children: A review. *Journal of Learning Disabilities, 10*, 141-146.

Quay, H. C. (1986). A critical analysis of DSM-III as a taxonomy of psychopathology in childhood and adolescence. In T. Million & G. L. Klerman (Eds.), *Contemporary directions in psychopathology: toward the DSM-IV*. NewYork: Guilford.

Quay, H. C. (1988a). Attention deficit disorder and the behavioral inhibition system: The relevance of the neuropsychological theory of Jeffrey A. Gray. In

L. M. Bloomingdale & J. A. Sergeant (Eds.), *Attention deficit disorder: Criteria, cognition, intervention*. New York: Pergamon.

Quay, H. C. (1988b). The behavioral reward and inhibition systems in childhood behavior disorder. In L. M. Bloomingdale (Ed.), *Attention deficit disorder III: New research in treatment, psychopharmacology, and attention* (pp. 176-186). New York: Pergamon.

Quay, H. C. (1993). The psychobiology of undersocialised aggressive conduct disorder: A theoretical perspective. *Development and Psychopathology, 5*, 165-180.

Quay, H. C. (1996). *Gray's behavioral inhibition in ADHD: An update.* Paper presented at the International Society for Research in Child and Adolescent Psychopathology, Los Angeles, CA.

Quay, H. C. (1997). Inhibition and attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology, 25*, 7-14.

Quiggle, N., Garber, J., Panak, W., & Dodge, K. A. (1992). Social-information processing in aggressive and depressed children. *Child Development, 63*, 1305-1320.

Rapport, M. D. (1987). Attention deficit disorder with hyperactivity. In M. Hersen & V. B. Van Hasselt (Eds.), *Behavior therapy with children and adolescents: A clinical approach.* New York: Wiley.

Rapport, M. D., Denney, C., DuPaul, G. J., & Gardner, M. J. (1994). Attention deficit disorder and methylphenidate: Normalisation rates, clinical effectiveness, and response prediction in 76 children. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 333-342.

Rasmussen, E. R., Neuman, R. J., Heath, A. C., Levy, F., Hay, D. A., & Todd, R. D. (2002). Replication of the latent class structure of attention deficit / hyperactivity disorder (ADHD) subtypes in a sample of Australian twins. *Journal of Child Psychology and Psychiatry, 43*, 1018-1028.

Rasmussen, E. R., Todd, R. D., Neuman, R. J., Heath, A. C., Reich, W., & Rohde, L. A. (2002). Comparison of male adolescent-report of attention-deficit / hyperactivity disorder (ADHD) symptoms across two cultures using latent class and principal components analysis. *Journal of Child Psychology and Psychiatry, 43*, 797-805.

Reeves, J. C., Werry, S., Elkind, G. S., & Zametkin, A. (1987). Attention deficit, conduct, oppositional and anxiety disorders in children: II. Clinical characteristics. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 144-155.

Richardson, G. A., Conroy, M. L., & Day, N. L. (1996). Prenatal cocaine exposure: Effects on the development of school age children. *Neurotoxicology and Teratology, 18,* 627-634.

Robins, E., & Guze, S. B. (1970). Establishment of diagnostic validity in psychiatric illness: its application in schizophrenia. *American Journal of Psychiatry, 126*, 983-987.

Rohde, L. A., Barbosa, G., Polanczyk, G., Eisirik, M., Rasmussen, E., Neumann, R. J., et al. (2001). Factor and latent class analysis of DSM-IV ADHD symptoms in a school sample of Brazilian adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*(6), 711-718.

Rohner, R. (1986). *The warmth dimension; Foundations of parental acceptance-rejection theory*. Beverly Hills, CA: Sage.

Ross, D. M., & Ross, S. A. (1982). *Hyperactivity: research, theory, and action* (2nd ed.). New York: Wiley.

Rowe, D. C., & Kandel, D. (1997). Parental ratings of externalising and internalising symptoms: DSM-IV questionnaire data. *Journal of Abnormal Child Psychology, 25*, 265-275.

Rugino, T. A., & Copley, T. C. (2001). Effects of modafinil in children with attention-deficit hyperactivity disorder: An open label study. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*(2), 230-235.

Rule, R. B. (1974). The hostile and instrumental functions of human aggression. In J. deWit & W. W. Hartup (Eds.), *Determinants and origins of aggressive behavior*. The Hague: Mouton.

Rutter, M. (1983). Behavioral studies: Questions and findings on the concept of a distinct syndrome. In M. Rutter. (Ed.), *Developmental neuropsychiatry* (pp. 279-357). New York: Guilford.

Rutter, M. (1988). DSM-III-R: A postscript. In A. H. Tuma & I. S. Lann (Eds.), *Assessment and diagnosis in child psychopathology* (pp. 453-464). New York: Guilford.

Rutter, M. (1989). Attention deficit disorder/ hyperkinetic syndrome: Conceptual and research issues regarding diagnosis and classification. In T. Sagvolden & T. Archer (Eds.), *Attention deficit disorder* (pp. 1-24). New Jersey: Erlbaum.

Rutter, M., & Sroufe, L. A. (2000). Developmental psychopathology: Concepts and challenges. *Development and Psychopathology, 12*, 265-296.

Rutter, M., Tizard, J., & Whitmore, J. (1970). *Education, health and behaviour*. London: Longmans.

Satorra, A., & Bentler, P. M. (1999). *A scaled chi-square test statistic for moment structure analysis*. (UCLA Statistics Series 260). Los Angeles: University of California, Department of Psychology.

Satterfield, J. H., Cantwell, D. P., & Satterfield, B. (1979). Muliti-modality treatment. *Archives of General Psychiatry, 36*, 965-974.

Satterfield, J. H., Satterfield, B., & Schell, A. (1987). Therapeutic interventions to prevent delinquency in hyperactive boys. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 56-64.

Satterfield, J. H., Swanson, J. M., Schell, A., & Lee, F. (1994). Prediction of antisocial behavior in attention-deficit hyperactivity disorder boys from aggression/defiant scores. *Journal of the American Academy of Child and Adolescent Psychiatry, 33*, 185-190.

Sattler, J. M. (1992). *Assessment of children*. J. M. Sattler: San Diego.

Sawyer, M. G., Arney, F. M., & Baghurst, P. A. (2001). The mental health of young people in Australia: Key findings from the child and adolescent component of the national survey of mental health and well-being. *Australian and New Zealand Journal of Psychiatry, 35, 806-814.*

Schachar, R. J. (1986). Hyperkinetic syndrome: Historical development of the concept. In E. Taylor (Ed.), *The overactive child*. Philadelphia: J. B. Lippincott.

Schachar, R. J., & Ickowicz, A. (1999). Pharmacological treatment of ADHD. In H. Quay & A. E. Hogan (Eds.), *Handbook of disruptive behavior disorders* (pp. 221-254). New York: Kluwer Academic/Plenum.

Schachar, R. J., & Logan, G. D. (1990). Impulsivity and inhibitory control in normal development and child psychopathology. *Developmental Psychopathology, 26*, 710-720.

Schachar, R. J., Sandberg, S., & Rutter, M. (1986). Agreement between teachers' ratings and observations of hyperactivity, inattentiveness, and defiance. *Journal of Abnormal Child Psychology, 14,* 331-345.

Schachar, R. J., & Tannock, R. (1993). Childhood hyperactivity and psychostimulants: A review of extended treatment studies. *Journal of Child and Adolescent Psychopharmacology, 3*, 81-97.

Schachar, R. J., Tannock, R., Cunningham, C., & Corkum, P. (1997). Behavioral, situational, and temporal effects of treatment of ADHD with methylphenidate. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 1-10.

Schachar, R. J., Tannock, R., & Logan, G. D. (1993). Inhibitory control, impulsiveness, and attention deficit hyperactivity disorder. *Clinical Psychology Review, 13*, 721-739.

Schachar, R. J., Tannock, R., Marriott, M., & Logan, G. D. (1995). Deficient inhibitory control in attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology, 23*, 411-438.

Schnake, S. B., Ruscher, J. B., Gratz, K. L., & O'Neal, E. C. (1997). Measure for measure? Male retaliation commensurate with anger depends on provocateur gender and aggression covertness. *Journal of Social Behavior & Personality, 12*, 937-956.

Schwab-Stone, M., Fischer, P., Piacentini, J., Shaffer, D., Davies, M., & Briggs, M. (1993). The Diagnostic Interview Schedule for Children-Revised Version

(DISC-R): II. Test-retest reliability. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 651-667.

Schwartz, D., Dodge, K. A., Coie, J. D., Hubbard, J. A., Hilleson, A. H., Lemerise, E. A., et al. (1998). Social-cognitive and behavioral correlates of aggression and victimisation in boys' play groups. *Journal of Abnormal Child Psychology, 26*, 431-440.

Seidman, L. J., Biederman, J., Weber, W., Hatch, M., & Faraone, S. V. (1997). Neuropsychological function in adults with attention-deficit hyperactivity disorder. *Biological Psychiatry, 44*, 260-268.

Semrud-Clikeman, M., Biederman, J., Sprich-Buckminster, S., Lehman, B. K., Faraone, S. V., & Norman, D. (1992). Comorbidity between ADDH and learning disability: A review report on a clinically referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 31*, 439-448.

Sergeant, J. A. (1995a). Hyperkinetic disorder revisited. In J. A. Sergeant (Ed.), *Eunethydis: European approaches to hyperkinetic disorder*. Amsterdam: Author.

Sergeant, J. A. (1995b). A theory of attention: An information processing perspective. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, and executive function*. Baltimore: Paul H. Brookes.

Sergeant, J. A., & van der Meere, J. (1988). What happens when the hyperactive child commits an error? *Psychiatry Research, 24*, 157-164.

Sergeant, J. A., & van der Meere, J. (1990a). Additive factor method applied to psychopathology with special reference to childhood psychopathology. *Acta Psychologica, 74*, 277-295.

Sergeant, J. A., & van der Meere, J. (1990b). Converging approaches on localising the hyperactivity deficit. In B. B. Lahey & A. E. Kazdin (Eds.), *Advancements in clinical child psychology* (Vol. 13). New York: Plenum Press.

Shapiro, S. K., Quay, H. C., Hogan, A. E., & Schwartz, K. P. (1988). Response perseveration and delayed responding in undersocialised aggressive conduct disorder. *Journal of Abnormal Psychology, 97*, 371-373.

Shaw, D. S., & Bell, R. Q. (1993). Developmental theories of parental contributors to antisocial behavior. *Journal of Abnormal Child Psychology, 21*, 35-49.

Shaywitz, S. E., & Shaywitz, B. E. (1988). Attention deficit disorders: Current perspectives. In J. F. Kavanaugh & T. J. Truss (Eds.), *Learning disabilities: Proceedings of the national conference* (pp. 369-523). Parkton, MD: York Press.

Sherman, D. K., Iacono, W. G., & McGue, M. K. (1997). Attention-deficit hyperactivity disorder dimensions: A twin study of inattention and impulsivity/hyperactivity. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 745-753.

Smith, A. (1962). Ambiguities in concept and studies of " brain damage" and "organicity". *Journal of Nervous and Mental Disease, 135*, 311-326.

Smith, B. H., Pelham, W. E., Gnagy, E., & Yudell, T. (1998). Equivalent effects of stimulant treatment for attention-deficit hyperactivity disorder during childhood and adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 314-321.

Smith, L. (1976). *Your child's behavior chemistry*. New York: Random House.

Sonuga-Barke, E. J. (1995). Disambiguating inhibitory dysfunction in childhood hyperactivity. In J. A. Sergeant (Ed.), *Eunethydis: European approaches to hyperkinetic disorder* (pp. 209-223). Amsterdam: Author.

Spencer, T. J., Biederman, J., Wilens, T. B., Harding, M., O'Donnell, D., & Griffin, S. (1996). Pharmacotherapy of attention-deficit hyperactivity disorder across the life cycle. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 409-432.

Spitzer, R. L., Davies, M., & Barkley, R. A. (1990). The DSM-III field trial of disruptive behavior disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 690-967.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research, 25*, 173-180.

Still, G. F. (1902). Some abnormal psychical conditions in children. *Lancet, 1*, 1008-1012; 1077-1082; 1163-1168.

Stormont-Spurgin, M., & Zentall, S. (1995). Contributing factors in the manifestation of aggression in preschoolers with hyperactivity. *Journal of Child Psychology and Psychiatry, 36*, 491-509.

Stormont-Spurgin, M., & Zentall, S. (1996). Child rearing practices associated with aggression in youth with and without ADHD: An exploratory study. *International Journal of Disability, Development and Education, 43*, 135-146.

Strauss, A. A., & Kephart, N. C. (1955). *Psychopathology and education of the brain-injured child* (Vol. 2). New York: Grune & Stratton.

Strauss, A. A., & Lehtinen, L. E. (1947). *Psychopathology and education of the brain-injured child.* New York: Grune & Stratton.

Strecker, E. A. & Ebaugh, F. G. (1924). Neuropsychiatric sequelae of cerebral trauma in children. *Archives of Neurology and Psychiatry, 22*, 443-453.

Streissguth, A. P., Barr, H. M., Sampson, P. D., & Bookstein, F. L. (1994). Prenatal alcohol and offspring development: The first fourteen years. *Drug and Alcohol Dependence, 36*, 89-99.

Swanson, J. M., Kinsbourne, M., Roberts, W. A., & Zucker, K. (1978). Time-response analysis of the effect of stimulus medication on the learning ability of children referred for hyperactivity. *Pediatrics, 61*, 21-29.

Swanson, J. M., Nolan, W. J., & Pelham, W. E. (1981). *A parent-teacher rating scale for operationalising DSM-III symptoms of attention deficit disorder.* Unpublished manuscript, University of California, Irvine.

Swanson, J. M., Sandman, C. A., Deutsch, C., & Baren, M. (1983). Methylphenidate hydrochloride given with or before breakfast: I. Behavioral, cognitive, and electro-physiologic effects. *Pediatrics, 72*, 49-55.

Szatmari, P., Offord, D. R., & Boyle, M. H. (1989). Ontario child health study: Prevalence of attention deficit disorder with hyperactivity. *Journal of Child Psychology and Psychiatry, 30*, 219-230.

Tannock, R., Ickowicz, A., & Schachar, R. J. (1995). Differential effects of methylphenidate on working memory in ADHD children with and without comorbid anxiety. *Journal of the American Academy of Child and Adolescent Psychiatry, 34*, 886-896.

Tannock, R., Schachar, R. J., Carr, R. P., Chajczyk, D., & Logan, G. D. (1989). Response perseveration and delayed responding in undersocialised aggressive conduct disorder. *Journal of Abnormal Child Psychology, 17*, 473-491.

Taylor, E. (1986). *The overactive child.* Philadelphia: J. P. Lippincott.

Taylor, E. (1989). On the epidemiology of hyperactivity. In S. T. Archer & T. Archer (Eds.), *Attention deficit disorder* (pp. 31-51). New Jersey: Erlbaum.

Teegarden, L. A., & Burns, G. L. (1999). 12-month stability of ADHD, oppositional defiant disorder, and conduct disorder symptoms in kindergarten through fifth grade children based on a single source: Usefulness of teacher ratings for the creation and study of the ADHD subtypes. *Child and Family Behavior Therapy, 21*(3), 53-70.

Tellegen, A., & Briggs, P. F. (1967). Old wine in new skins: Grouping Weschler subtests into new scales. *Journal of Consulting Psychology, 31*, 499-506.

The Psychological Corporation. (1983). *Basic Achievement Skills Individual Screener*. San Antonio, TX: Author

Thomson, G. O., Raab, G. M., Hepburn, W. S., Hunter, R., Fulton, M., & Laxen, D. P. (1989). Blood lead levels and children's behavior: Results from the Edinburgh lead study. *Journal of Child Psychology and Psychiatry, 30*, 515-528.

Todd, R. D., Rasmussen, E. R., Neuman, R. J., Reich, W., Hudziak, J. J., Bucholz, K. A., et al. (2001). Familial and heritability of subtypes of attention deficit hyperactivity disorder in a population sample of adolescent female twins. *American Journal of Psychiatry, 158*, 1891-1898

Tomada, G., & Schneider, B. H. (1997). Relational aggression, gender, and peer acceptance: Invariance across culture, stability over time, and concordance among informants. *Developmental Psychology, 33*, 601-609.

van der Meere, J., Vreeling, H. J., & Sergeant, J. A. (1992). The additive factor method: A differential diagnostic tool in hyperactivity and learning disablement. *Journal of Abnormal Child Psychology, 17*, 409-422.

van der Vlugt, H., Pijnenburg, H., Wels, P. M., & Koning, A. (1995). Cognitive behavior modification of ADHD: A family system approach. In H. P. van Bilsen & J. G. van Bilsen (Eds.), *Behavioral approaches for children and adolescents*. New York: Plenum.

Vance, A. A., & Luk, E. S. (1998). Attention deficit hyperactivity disorder and anxiety: is there an association with neurodevelopmental deficits? *Australian and New Zealand Journal of Psychiatry, 32*, 650-657.

Vaughn, M. L., Riccio, C. A., Hynd, G. W., & Hall, J. (1997). Diagnosing ADHD (predominantly inattentive and combined type subtypes): Discriminant validity of the Behavior Assessment System for Children and the Achenbach parent and teacher rating scales. *Journal of Clinical Child Psychology, 26*, 349-357.

Venables, P. H., Fletcher, R. P., Dalais, J. C., Mitchell, D. A., Schulsinger, F., & Mednick, A.(1983). Factor structure of the Rutter "children's behaviour questionnaire" in a primary school population in a developing country. *Journal of Child Psychology and Psychiatry, 24*, 213-222.

VerFaellie, M., & Heilman, K. M. (1987). Response preparation and response inhibition after lesions of the medial frontal lobe. *Archives of Neurology, 44*, 1265-1271.

Waldman, I. D., Lilienfeld, S. O., & Lahey, B. B. (1995). Toward construct validity in the childhood disruptive behavior disorders: Classification and diagnosis in DSM-IV and beyond. In T. H. Ollendick & R. J. Prinz (Eds.), *Advances in clinical child psychology* (Vol. 19, pp. 323-363). New York: Plenum.

Waltonen, J. P., Olson, S. J., Theye, K. A., Van Erem, A. J., & LaPlant, R. J. (1993). Placebo-controlled evaluation of ritalin side-effects. *Pediatrics, 91*(6), 1101-1106.

Waschbusch, D. A., Willoughby, M. T., & Pelham, W. E. (1998). Criterion validity and the utility of reactive and proactive aggression: Comparisons to attention deficit hyperactivity disorder, oppositional defiant disorder, conduct disorder, and other measures of functioning. *Journal of Clinical Child Psychology, 27*, 396-405.

Weiler, M. D., Bellinger, D., Marmor, J., Rancier, S., & Waber, D. (1999). Mother and teacher reports of ADHD symptoms: DSM-IV questionnaire data. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 1139-1147.

Weiss, B., Dodge, K. A., Bates, J. E., & Pettit, G. S. (1992). Some consequences of early harsh discipline: Child aggression and a maladaptive social information processing style. *Child Development, 63*, 1321-1335.

Weiss, G., & Hechtman, L. (1993). *Hyperactive children grown up*. (2nd ed.). New York: Guilford.

Wender, P. H. (1971). *Minimal brain dysfunction in children*. New York: Wiley.

Werry, J. E., Reeves, J. C., & Elkind, G. S. (1987). Attention deficit, conduct, opposition and anxiety disorders in children: I. A review of research on differentiating characteristics. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 133-143.

Werry, J. S., Weiss, G., & Douglas, V. I. (1964). Studies on the hyperactive child. I. Some preliminary findings. *Canadian Psychiatric Association Journal, 9*, 120-130.

Weschler, D. (1991). *Weschler Intelligence Scale for Children-III (WISC-III).* San Antonio, TX: Psychological Corporation.

Weschler, D. (1992). *Weschler Individual Achievement Test – Manual. (WIAT).* San Antonio, TX: Psychological Corporation.

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with nonnormal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56-75). Thousand Oaks, CA: Sage.

Whalen, C. K., & Henker, B. (1976). Psychostimulants and children: A review and analysis. *Psychological Bulletin, 83*, 1113-1130.

Whalen, C. K., & Henker, B. (1997). Stimulant pharmacotherapy for attention-deficit/hyperactivity disorders: An analysis of progress, problems, and prospects. In T. Fisher & R. Greenberg (Eds.), *From placebo to panacea: Putting psychiatric drugs to the test.* New York: Wiley.

Whalen, C. K., Henker, B., Collins, B., McAuliffe, S., & Vaux, A. (1979). Peer interaction in structured communication task: Comparisons of normal and hyperactive boys and methylphenidate (Ritalin) and placebo effects. *Child Development, 50*, 388-401.

Whalen, C. K., Henker, B., & Hinshaw, S. P. (1985). Cognitive-behavioral therapies for hyperactive children: Premises, problems and prospects. *Journal of Abnormal Child Psychology, 13*, 391-410.

Wheeler, J. C., & Carlson, C. L. (2000). Social functioning and emotional regulation in the attention deficit hyperactivity disorder subtypes. *Journal of Clinical Child Psychology, 29*, 30-50.

Willcutt, E. G., Pennington, B. F., Chhabildas, N. A., Friedman, M. C., & Alexander, J. (1999). Psychiatric comorbidity associated with DSM-IV ADHD in a nonreferred sample of twins. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 1355-1362.

Winefield, A. H., Goldney, R. D., Tiggeman, M., & Winefield, A. H. (1989). Reported parental rearing patterns and psychological patterns: A short form of the EMBU. *Personality and Individual Differences, 10*, 459-465.

Winefield, A. H., Goldney, R. D., Tiggeman, M., & Winefield, A. H. (1990). Parental rearing behaviours: Stability of reports over time and relation to adult interpersonal skills. *Journal of Genetic Psychology, 151*, 211-219.

Winefield, H. R., Tiggeman, M., & Winefield, A. H. (1994). Parental rearing behaviour, attributional style and mental health. In C. Perris, W. Arrindell, & M. Eisemann (Eds.), *Parenting and psychopathology* (pp. 33-53). Chichester: Wiley.

Wolraich, M. L., Feurer, I. D., Hannah, J. N., Baumgaertel, A., & Pinnock, T. Y. (1998). Obtaining systematic teacher reports of disruptive behavior disorders utilising DSM-IV. *Journal of Abnormal Child Psychology, 26*, 141-152.

Wolraich, M. L., Hannah, J. N., Pinnock, T., Baumgaertel, A., & Brown, J. (1996). Comparison of diagnostic criteria for attention-deficit hyperactivity disorder in a county-wide sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 35*, 319-324.

Wolraich, M. L., Lindgren, S. D., Stumbo, P. J., Stegink, L. D., Applebaum, M. I., & Kiritsy, M. C. (1994). Journal article reviews: Effects of diets high in sucrose or aspartame on the behavior and cognitive performance of children. *Developmental and Behavioral Pediatrics, 15*, 23-27.

Wolraich, M. L., Milich, R., Stumbo, P., & Schultz, F. (1985). The effects of sucrose ingestion on the behavior of hyperactive boys. *Journal of Pediatrics, 106*, 675-682.

World Health Organisation. (1978). *Mental disorders: Glossary and guide to their classification in accordance with the ninth revision of the international classification of diseases.* Geneva, Switzerland: Author.

World Health Organisation. (1992). *International classification of disease* (10th ed.). Geneva, Switzerland: Author.

Yang, K. N., Schaller, J. L., & Parker, R. (2000). Factor structure of Taiwanese teachers' ratings of ADHD. *Journal of Learning Disabilities, 23*, 72-82.

Zahn, T. B., Abate, F., Little, B. C., & Wender, P. H. (1975). Minimal brain dysfunction, stimulant drugs and autonomic nervous system activity. *Archives of General Psychiatry, 32*, 381-387.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no interferences. *American Psychiatrist, 35*, 151-175.

Zentall, S. (1985). Stimulus control factors in search performance of hyperactive children. *Journal of Learning Disabilities, 18*, 480-485.

Zentall, S. (1989). Self-control training with hyperactive and impulsive children. In J. N. Hughes & R. J. Hall (Eds.), *Cognitive-behavioral psychology in the schools: A comprehensive handbook.* New York: Guilford.

Zentall, S. (1993). Research on the educational implications of attention deficit hyperactivity disorder. Issues in the education of children with attentional deficit disorder (Special issue). *Exceptional Children, 60*, 143-155.

Appendix 1

CHILD'S NAME ________________ Age _____ Gender ______

Circle the number in the *one* column which best describes the child.

	Not at all	Just a little	Pretty much	Very much
1. Fails to give attention to details or makes careless mistakes in schoolwork.	0	1	2	3
2. Has difficult sustaining attention in task or play activities.	0	1	2	3
3. Does not seem to listen when spoken to directly.	0	1	2	3
4. Does not follow through on instructions and fails to finish schoolwork or chores.	0	1	2	3
5. Has difficulty organising tasks and activities.	0	1	2	3
6. Avoids, dislikes, or reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework).	0	1	2	3
7. Loses things necessary for tasks or activities (e.g., toys, school assignments. pencils, or books).	0	1	2	3
8. Easily distracted by extraneous stimuli.	0	1	2	3
9. Forgetful in daily activities.	0	1	2	3
10. Fidgets with hands or feet or squirms in seat.	0	1	2	3
11. Leaves seat in classroom or in other situations in which remaining seated is expected.	0	1	2	3
12. Runs about or climbs excessively in situations in which it is inappropriate.	0	1	2	3
13. Has difficulty playing or engaging in leisure activities quietly.	0	1	2	3
14. Is "on the go" or acts as if "driven by a motor".	0	1	2	3
15. Talks excessively.	0	1	2	3
16. Blurts out answers before questions have been completed.	0	1	2	3
17. Has difficulty awaiting turns.	0	1	2	3
18. Interrupts or intrudes on others (e.g., butts into conversation or games).	0	1	2	3
19 Loses temper.	0	1	2	3

PLEASE TURN OVER FOR MORE QUESTIONS

	Not at all	Just a little	Pretty much	Very much
20 Argues with adults	0	1	2	3
21 Actively defies or refuses to comply with adult's requests or rules	0	1	2	3
22. Deliberately annoys people.	0	1	2	3
23. Blames others for his or her mistakes or misbehaviour.	0	1	2	3
24. Is touchy or easily annoyed by others.	0	1	2	3
25. Is angry or resentful.	0	1	2	3
26. Is spiteful or vindictive.	0	1	2	3
27. Is worried, worries about many things	0	1	2	3
28. Fearful or afraid of new things or new situations	0	1	2	3
29. Complains of upset tummy, feeling sick	0	1	2	3
30. Has tears on arrival at school or reluctant to enter school building	0	1	2	3
31. Has sleeping difficulties	0	1	2	3

To the best of your knowledge, has this child been diagnosed by a doctor or a psychologist as having:

1. (a) Attention Deficit Disorder or Attention Deficit Hyperactivity Disorder? Yes/No (circle)
   (b) Oppositional Defiant Disorder? Yes/No (circle)
   (c) Learning Disorder? Yes/No (circle)

2. To the best of your knowledge, has the child a motor, sensory or intellectual disability? Yes/No (circle)

3. To the best of your knowledge does this child have severe problems in the following settings:

   (i) social activities- play with friends and classmates Yes/No (circle)
   (ii) school work and within the classroom Yes/No? (circle)
   (iii) jobs/activities around the home? Yes/No? (circle)

4. To the best of your knowledge did inattention or hyperactivity/impulsivity cause behavioural problems before age 7 years. Yes/No (circle)

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

Appendix 2

CHILDREN'S BEHAVIOURAL SCALE

The following scale describes children's problem behaviours. Could you please place a tick (✔) in one of the boxes besides each statement to indicate the degree to which you agree or disagree with each statement describing the child's behaviour

	Never	Sometimes	Very Often
1. plays mean tricks			
2. has hurt others to win a game			
3. threatens others			
4. gets mad when doesn't get own way			
5. writes things on walls			
6. changes rules to win			
7. poor loser			
8. does sneaky things			
9. tells things that aren't true			
10. won't admit his/her fault			
11. needs to be the leader			
12. takes things from other students			
13. gets mad when corrected			
14. says mean things about others			
15. gets mad for no good reason			
16. causes trouble but not caught			
17. picks on smaller kids			
18. gets others to gang up			
19. blames others			
20. fights for no good reason			
21. acts out behind teacher's back			

Appendix 3

Child's name____________________ Age________ Sex________

EMBU SCALE

Below are some descriptions of how parents behave with their children.
Place a number between (1) **"no, never"** to (4) **"yes, most of the time"** in the space at the end of each statement to indicate the degree to which you agree/disagree with each statement.

1 = No, Never	**2 = Seldom**	**3 = Often**	**4 = Yes, most of the time**

Describe your mother's behaviour now:

1. When you come home, you have to tell your mother what you've been doing. ________
2. When you are unhappy your mother consoles you and cheers you up. ________
3. Your mother wants you to reveal your secrets to her. ________
4. Your mother tells you that she doesn't like your behaviour at home. ________
5. Your mother likes you just the way you are. ________
6. Your mother tells you things like "if you do that you will make me sad". ________
7. Your mother plays with you and is interested in your hobbies. ________
8. Your mother treats you unfairly. ________
9. Your mother worries about what you are doing after school is out. ________
10. Your mother listens to you and considers your opinions. ________
11. Your mother wishes that you were like somebody else. ________
12. You feel guilty when you have behaved in a way that your mother disapproves of. ________
13. You are treated as the "black sheep" of the family, you are blamed for everything that goes wrong. ________
14. Your mother punishes you for no reason. ________
15. Your mother wants to be with you ________

16. Your mother wants to decide how you should dress or how you should look. ________

17. Your mother shows that she loves you ________

18. Your mother criticises you in front of others. ________

19. Your mother is scared that something might happen to you. ________

20. Your mother encourages you to enjoy yourself and learn things. ________

21. You feel disappointed because your mother doesn't give you what you want. ________

22. Your mother doesn't give you everything because she doesn't want you to become a spoilt child. ________

23. When things aren't going well for you, your mother tries to console or help you. ________

24. You feel that your mother and you like each other. ________

25. You think that your mother is mean and grudging to you. ________

26. Your mother not only tells you that she loves you, but she also hugs and kisses you. ________

27. When you've done something stupid, you can make it up with your mother. ________

28. Your mother tells you off for no reason. ________

29. Your mother forbids you to do things, because she is afraid that something bad might happen to you. ________

30. Your mother gives you compliments. ________

31. You are the one whom your mother blames if anything goes wrong at home. ________

32. When you have done something that isn't allowed your mother looks so sad that you feel guilty. ________

33. Your mother helps you when have to do something difficult. ________

34. Your mother trusts you and allows you to make your own decisions. ________

Appendix 4

STORY. 1

You are at the beach eating an ice-cream. A child throws sand in your direction. Some sand lands on you and your ice-cream.

QUESTIONS TO BE ANSWERED

1. Why did he/she throw the sand?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

STORY 2

You have a beautiful new picture book on your favourite pop-star. A child picks up the book. He/she has really dirty hands and mucks up your book.

QUESTIONS TO BE ANSWERED

1. Why did he/she muck up your book?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

STORY. 3

You are really hungry. You buy a big juicy burger and are about to eat it. A basketball thrown by a child knocks it off the table onto the ground.

QUESTIONS TO BE ANSWERED

1. Why did he/she throw the basketball?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

STORY. 4

It's a wet day and you are wearing new sneakers. A child is riding his/her bike nearby. He/she rides close to you splashing your new sneakers.

QUESTIONS TO BE ANSWERED

1. Why did he/she ride close to you?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

STORY. 5

You are doing work in the computer room. A child is playing with a ball. The ball hits your keyboard ruining your work.

QUESTIONS TO BE ANSWERED

1. Why did he/she throw the ball?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

STORY. 6

You are playing with your remote controlled car. A child is carrying a heavy box. He/she drops the box and it smashes your toy car.

QUESTIONS TO BE ANSWERED

1. Why did he/she drop the box?

If no intentional attribution is given (ie., purposeful or accidental action) then ask question 1. (b).

1 (*b*) Did he/she do it : on purpose?
accidentally?

2. What would you next after this happened?

3. How would you feel after this happened? *(circle one of the below)*
   (a) OK
   (b) Not so good
   (c) Upset
   (d) Quite upset
   (e) Angry

Appendix 5

THE GHQ 28

Please read this carefully.

We should like to know if you have had any medical complaints and how your health has been in general, ***over the past few weeks***. Please answer ALL the questions on the following pages simply by circling the answer which you think most nearly applies to you. Remember we want to know about **present and recent complaints**, not those that you had in the past.

It is important that you try to answer ALL the questions.

Have you recently

A1 been feeling perfectly well and in good health?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A2 been feeling in need of a good tonic?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A3 been feeling run down and out of sorts?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A4 felt that you are ill?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A5 been getting any pains in your head?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A6 been getting a feeling of tightness or pressure in your head?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A7 been having hot or cold spells?	Better than usual	Same as usual	Worse than usual	Much worse than usual
B1 lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
B2 had difficulty in staying asleep once you are off?	Not at all	No more than usual	Rather more than usual	Much more than usual
B3 felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
B4 been getting edgy and bad-tempered?	Not at all	No more than usual	Rather more than usual	Much more than usual
B5 been getting scared or panicky for no good reason?	Not at all	No more than usual	Rather more than usual	Much more than usual
B6 found everything getting on top of you?	Not at all	No more than usual	Rather more than usual	Much more than usual
B7 been feeling nervous and strung-up all the time?	Not at all	No more than usual	Rather more than usual	Much more than usual

Have you recently

C1 been managing to keep yourself busy and occupied?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C2 been taking longer over the things you do?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C3 felt on the whole you were doing things well?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C4 been satisfied with the way you've carried out your task?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C5 felt that you are playing a useful part in things?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C6 felt capable of making decisions About things?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C7 been able to enjoy you normal day-to-day activities?	More so than usual	Same as usual	Rather less than usual	Much less than usual

---

D1 been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual
D2 felt that life is entirely hopeless?	Not at all	No more than usual	Rather more than usual	Much more than usual
D3 felt that life isn't worth living?	Not at all	No more than usual	Rather more than usual	Much more than usual
D4 thought of the possibility that you might make away with yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
D5 found that at times you couldn't do anything because your nerves were too bad?	Not at all	No more than usual	Rather more than usual	Much more than usual
D6 found yourself wishing you were dead and away from it all?	Not at all	No more than usual	Rather more than usual	Much more than usual
D7 found that the idea of taking your own life kept coming into your head?	Not at all	No more than usual	Rather more than usual	Much more than usual

A	B	C	D	Total

Appendix 6

FAMILY BACKGROUND INFORMATION

1. Mothers' name ______________________________

2. Mother's occupation (if now at home, previous occupation)

____

3. Mother's education (age left school)

____

4. Is the child living with two parents? **YES / NO**

5. Is your child taking medication? **YES / NO**

6. Is your child taking ritalin or dexamphetamine medication? **YES / NO**

7. If your child is taking medication, please indicate the length of time your child has been taking medication ________________

8. Have you received specialised training from health professionals in the behavioural management of your child? **YES / NO**

Appendix 7

Formula for converting scaled scores to deviation IQ scores

In this procedure short form IQ scores are transformed into Weschler type Deviation Quotients (DQ's) which have a mean of 100 and a SD of 15. Formulas are based on Tellegen and Briggs (1967) linear scaling technique. The following formula for the Vocabulary and Block Design 2 item test (Herrera-Graf, Dipert, & Hinton, 1996) is used for converting the short-form scores into DQ's.

$$DQ = 2.9(Xc) + 42$$

where Xc = composite score (sum of subtest scores).